Foreign vs. domestic public debt and the composition of government expenditure

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Diplom-Volkswirt Joachim Lutz

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The recent financial crisis forced many central governments – especially of those countries that are considered to be the advanced nations – to accumulate large piles of additional sovereign debt in order to ensure and guarantee the maintenance of the domestic and international financial markets. After surmounting most of the difficulties on the private sector, the question of sustainability of the public debt burden has gained attention in economic science again (e.g. Ghosh et al. (2013), Panizza and Presbitero (2014), Checherita-Westphal et al. (2014)). In this context, the spotlight has also turned to the ownership of public liabilities. Whereas this had been identified as an important feature of a country's financial status for less advanced nations already previously (see Beaugrand et al. (2002), Guscina and Jeanne (2006), or for the original sin argument Eichengreen et al. (2007)), the ownership structure of high income countries' public debt received merely few consideration. But since only recently some of them were close to default or even had to restructure their debt (cf. Gulati et al. (2013)), it will be even more important for all sovereign debtors to think about the ownership structure of their liabilities already before issuing.

From a theoretical point of view, the nationality of the creditor has a substantial economic impact, since borrowing abroad involves a transfer of resources from within the country (public or private) to a non-resident. On the other hand, for the sovereign as a debtor there are also different implications whether debt is held domestically or externally: in order to repay the former, a government could always levy an additional tax (which is then a de facto expropriation of the residents) or – as far as it has control over its monetary policy – try to raise inflation to lower the value of outstanding domestic debt. For the treatment of external debt, these measures are out of reach for the domestic policymaker. Conversely, foreigners might be able to impose some harmful measures on the defaulting

nation like trade restrictions, the loss of influence within the international institutions or even the seizure of the country's foreign assets as recently in the Argentinian litigation against US creditors. Therefore, also in advanced countries external and domestic debt are no perfect substitutes (see Drazen (1998) for a theoretical model on the distinction of both kinds of debt.).
Closely related with the budgetary issues arising on the income side is the discussion about the expenditure side, i.e. how to spend the public funds. However, the empirical literature is quite divided on the question of how to structure public expenditure best. On the one hand there is evidence for growth enhancing effects from shifts towards public investment, i.e. spending on infrastructure, education, etc. (cf. Acosta-Ormaechea and Morozumi (2013) or Kneller and Misch (2014)), whereas some studies also find the opposite effect (see for instance Cavallo and Daude (2011)), since too much public could crowd out private investment. However, the focus of this work is rather on the exogenous circumstances – namely country-specific economic parameters – that determine the government's decision about the composition of expenditure. As also Kuehnel (2011) shows, the age structure of a society can explain the spending behavior of policymakers to some significant extent. Not very surprisingly, the larger older age groups are, the less productive will the government use its funds. Furthermore, the productivity of an economy seems to have the opposite effect.
However, these country characteristics do affect the decision about the public debt profile as well. For instance, think of the fact that older societies are mainly dissaving, thus reducing the policymakers scope for issuing domestic debt. Accordingly, this work contributes to the existing literature by detecting an economic link between the public expenditure choice and the decision where to issue debt.

In the first chapter I (together with Philipp Harms) develop a theoretical model of where governments borrow and how they spend these funds. In a two period OLG setting with two generations the policymaker has to decide on how much of its debt to issue abroad and domestically on the one hand, and whether to use these funds for either investment-related expenditures or public transfers on the other hand. Whereas the latter allows the young as well as the old generation's members to expand current consumption, the former builds up the economy's capital stock and transforms into enhanced income in the next period. This involves an intergenerational conflict, since the older cohort is strongly in favor of public transfers, because they will die after one period and therefore not be able to reap the future gains of today's public investment. The young members of the society, though, prefer some amount of investment in order to maximize lifetime utility via consumption smoothing. Additionally, both generations differ with respect to their desired amount of public foreign debt: naturally, the older ones want the government to borrow as much as possible externally, while the younger ones also consider that either repayment or default (via output/income losses) cause some costs for next period's economy and therefore prefer a lower level of foreign debt.

The government as the key player of the model maximizes a weighted sum of the two generations' utilities with respect to its budget constraint. In equilibrium, the optimal expenditure profile as well as the debt structure is mainly shaped by three country characteristics: the productivity of the economy, the vulnerability in case of default, and the relative size (or political power) of the older cohort.

The Total Factor Productivity (TFP) has a positive effect on public investment and therewith boosts the future period's household income which, in turn, leads to higher savings and thus higher demand for domestic debt. On the contrary, higher possible output losses in case of a default on outstanding debt make this very event less likely to occur which allows the policymaker to borrow more abroad. At the same time more of these additional funds are used for public transfers. Finally, since the above described intergenerational conflict is incorporated in the government's objective function, also the (relative) size of the generations matters for the political decisions leading to the preferences described above.

Consequently, if the determination of both the public financing as well as the expenditure decision is influenced by these three determinants, this indicates that there is indeed a (theoretical) link between those two choices.

The second chapter is then validating the theoretical results, confirming the link via the three country characteristics. Therefore, I assemble a new dataset that is based on Panizza (2008)'s data about the composition of central government debt. I enlarge this

sample by adding data for more recent years. However, using a large set of controls limits the sample size, but I'm still able to derive results in the narrowest sample for 29 countries.
After mathematically deriving the marginal effects of TFP, default costs, and demographic structure, I test whether these factors do have the predicted effects on the public investment share in government expenditure, the ratio of foreign debt in total public debt, and the parameter that determines the relationship between the latter two quotas. In general, I find strong evidence for the TFP fostering productive spending and lowering the share of external borrowing at the same time. Thus, the effect of this measure on the link of both decisions is also significantly positive. Additionally, the impact of the relative size of the older cohorts is found to be exactly the opposite: the larger the older age group(s), the less will be invested and the more foreign debt is accumulated, meaning that the link of the public choices is negatively influenced by this variable. This is again significantly in line with results that the theoretical model predicts. Last, the influence of the possible default costs is relatively rarely found in the data. For the debt decision as well as for the choice of public spending there is no significant effect. The third chapter draws on this observation by endogenizing this variable. All in all, these results are found to be very robust with respect to the set of control variables, lags and sample size.
The second chapter also answers the question whether the theoretical model is an illustration of any country regardless of its income level. Therefor, I divide the sample in advanced and less advanced nations and find that the two variables that showed the most significant impact – TFP and age structure – do the same for the rich countries. For the poorer nations, however, the effects have the same direction but remain insignificant. Thus, the theoretical model seems to image the government's behavior in advanced countries in a more convincing way.

The third chapter then draws on the poor performance of the default cost variable in the empirical validation. I extend the basic theoretical model by endogenizing this variable. The idea behind is that a government's spending behavior might well serve as a signal for foreign lenders about the country's creditworthiness, i.e. how likely future rewards will be generated that can be used to repay debt. This would then influence today's lending decision of international investors. I incorporate this in the model by substituting the formerly exogenously determined maximum default costs by the economy's income. The latter is generated by the previous period's public investment, which means that the government now has some control over its perceived creditworthiness, i.e. to some extent over the price and/or the amount of debt that is offered by external lenders. Thus, if the policymaker opts for a larger share of public investment this results in a larger volume of foreign debt.

However, this effect is changing the results of the basic model mainly in three ways: First, it makes the optimal amount of external debt positively depending on the productivity. Second, the impact of the TFP on the share of public investment in total government expenditure turns negative, which is a result of the first change combined with the fact that these additional funds are mainly channeled into public transfers. Last but most importantly, the variable that links both of the policymaker's decisions is no longer depending on the productivity measure. Therewith, a nation's age structure is the key country characteristic that explains the relationship of where to borrow and how to spend.

While the empirical analysis of the changes compared to the basic model confirms them only partly, the support for the negative effect of the demographic composition on the link of public expenditure and public debt is still strong. Additionally, also the fact that the model describes the policy of advanced nations better is empirically approved for the extended version.

The last chapter will sum up the main findings of this thesis and conclude.

2 Foreign vs. domestic public debt and the composition of government expenditure: A political-economy approach

This chapter is joint work with Philipp Harms[1].

2.1 Introduction

In the context of the recent financial turmoil, a lot of attention has been devoted to the level and sustainability of public debt. But while the economic literature on the topic is growing rapidly, most studies ignore the fact that almost every country borrows money abroad as well as from its residents. In fact, a casual look at the evidence reveals that governments differ a great deal with respect to the structure of their debt.[2] As documented by the histogram in figure 2.1, which presents country averages for the period 1996 to 2000, the median in that time periods was 49.5 percent, with external-debt shares ranging from close to 0 percent (Switzerland) to more than 90 percent (Tajikistan). However, large external-debt shares are no developing-country-specific phenomenon: while the average share of foreign debt in total government debt for the United Kingdom was 15 percent

[1] Johannes Gutenberg University Mainz, Jakob-Welder-Weg 4, 55128 Mainz, Germany
[2] A large dataset that decomposes public debt into its domestic and foreign components has been compiled by Panizza (2008). We are indebted to Ugo Panizza for making this dataset available to us.

between 1996 and 2000, this share was 39 percent for Australia, 45 percent for Denmark, and 86 percent for Estonia.

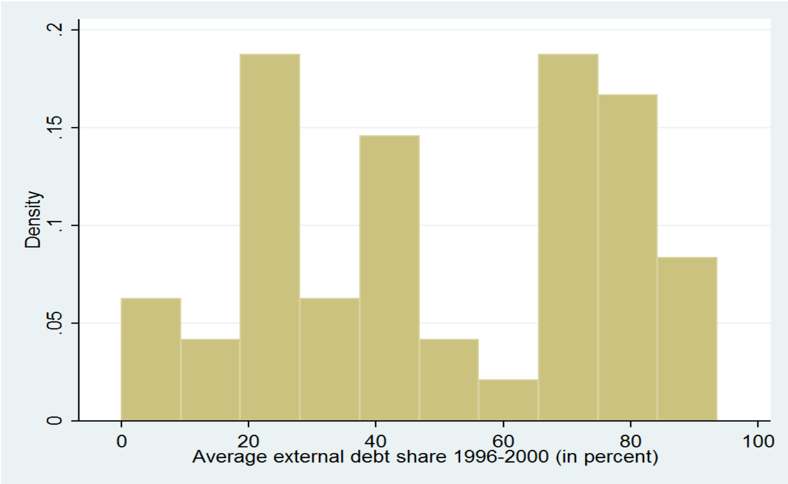

Figure 2.1: Share of external public debt in total public debt. Average, 1996 - 2000 (in percent). Data source: Panizza (2008)

Are these differences related to governments' spending decisions, specifically the share of investment in total public expenditure? It could be argued that a large external debt burden disciplines governments and induces them to use the borrowed funds more productively. Conversely, the option to *default* on foreign liabilities might run in the opposite direction and raise the share of non-productive government spending. A first look at the data suggests that there is a positive, though weak correlation (*53.25 percent*) between a government's financing and spending decisions: figure 2.2 shows that countries issuing relatively more debt abroad choose higher investment shares.

In this chapter, we argue that the structure of government debt and the composition of public spending are indeed closely related – however, not through a simple causal tie, but due to the fact that the two magnitudes are driven by the same fundamental forces. To support our claim, we present an overlapping generations model of a small open economy, whose government decides on the level of public investment and the volume of transfers in every period. Public spending is financed by raising public debt, and, for a given domestic demand for government bonds, the government has to decide how much money to raise on international capital markets. When making these decisions, the government considers the preferences of the two generations currently alive, with the weight of old and young agents in the government's objective function reflecting the relative political influence of

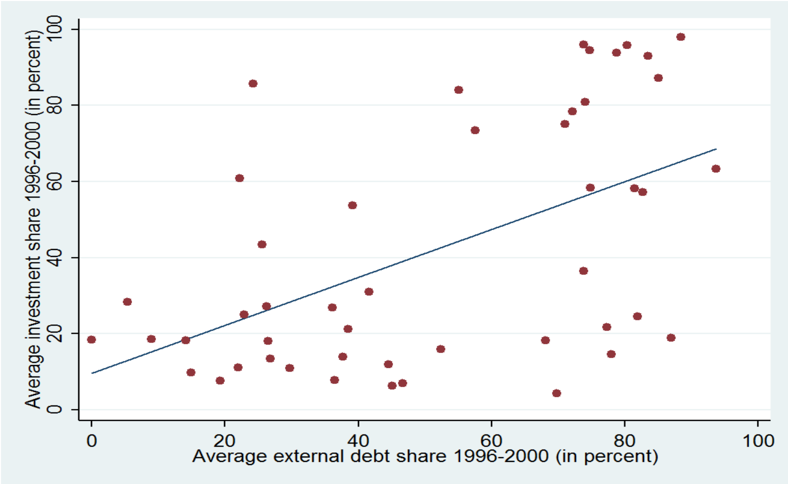

Figure 2.2: The structure of government debt and the composition of public spending. Averages: 1996-2000 (in percent). The vertical axis depicts the ratio of public investment over public transfers and investment – the ratio we will focus on in our subsequent analysis. Data source: Panizza (2008), OECD and World Bank (WDI)

these generations. We show that the government's spending and financing decisions are intertwined in various ways: for example, public investment raises domestic income and thus the supply of domestic savings, thereby reducing the share of foreign liabilities in total government debt. Conversely, a higher stock of foreign debt raises the likelihood of default and thus the effective costs of foreign borrowing. This, in turn, reduces the government's generosity when it comes to handing out transfers to its population.

We use our model to identify the following *exogenous* factors that determine the government's financing and spending decisions: the effect of public investment on aggregate productivity, the political weight of different generations, and the expected output cost of sovereign default: the stronger the impact of current public investment on future output, the higher the incentive to use government resources for investment purposes. Moreover, higher public investment raises domestic incomes and savings, which, in turn, reduces the need to tap international capital markets. The relative political weights of the two generations matter since old agents put a much higher emphasis on public transfers than on public investment – an obvious preference, since the benefits of public investment only accrue to *future* cohorts. This effect pulls down income and aggregate savings, and thus raises the need to borrow abroad. Finally, the larger the income losses that are expected in case of default, the greater the share of foreign debt in total public debt, since a lower likelihood of default reduces the expected costs of foreign debt. The same mechanism raises public transfers and thus lowers the share of public investment in total government expenditure. These findings suggest that there is, indeed, a positive relationship between the structure of public debt and the composition of government spending.

The remainder of this chapter is organized as follows. The next section reviews related studies on the composition of public spending, the structure of government debt, and on sovereign default. In section 3 we present and solve our model and derive the effects of varying crucial economic parameters. Section 4 summarizes and concludes.

2.2 Literature

Our approach is related to three large strands of literature: on the composition of public spending, on the level and structure of government debt, and on the determinants and consequences of sovereign default. While the first two aspects are the topic of numerous welfare-oriented analyses,[3] our brief – and admittedly non-exhaustive – literature review focuses on those studies that explore the political economy of the government's spending and financing decisions.

Bassetto and Sargent (2006) analyze the political mechanisms that shape the decision on public investment and find theoretical support for the implementation of investment enhancing rules when finitely-lived agents do not take into account the welfare of future generations and vote for a sub-optimal level of public capital formation. The role of inter-generational conflict is further emphasized in the OLG models of Bassetto (2008) and Kaas (2003). The latter contribution shows how a government's policy on tax-financed public investment is shaped by the voting behavior of generations that differ with respect to the gains and losses from taxes and public investment. However, since the population

[3] See Lindbeck and Weibull (1988), Barro (1990), Kellermann (2007) and Ganelli and Tervala (2010) for the growth and welfare effects of alternative forms of government spending. Empirical analyses on the growth effects of domestic vs. foreign debt are offered by Buffie et al. (2012), Abbas and Christensen (2010), Pattillo et al. (2011), Panizza (2008) and Presbitero (2012).

growth rate is positive, government policy essentially reflects the preferences of the young generation. Bassetto (2008) adds the notion that – via the joint determination of taxes, transfers and public goods – each generation's strategic position for the next bargaining round is determined. Poutvaara (2006) shows how tax-financed public investment in education and social security can be sustained in an environment with repeated voting.

The political economy of public debt goes back to the seminal contribution of Cukierman and Meltzer (1989) who relate the government's borrowing decision to an intragenerational distributional conflict. More recently, Van Rijckeghem and Weder di Mauro (2004), Battaglini and Coate (2008) and Yared (2010) have analyzed the economic and political forces that determine the level of public debt in equilibrium. Unlike in our work, however, government revenue is devoted to public goods and rents, and government bonds are exclusively held by domestic residents. The latter assumption is relaxed in Song et al. (2012) who analyze the determinants of government spending in a multi-country world. However, in their model, all international debt contracts are perfectly enforceable, and default is excluded by assumption.

There are only few papers that link the government's spending decision to the composition of its debt. Exceptions are the works by Mahdavi (2004) and Alper et al. (2008). The latter investigate how a government's preferences over different spending types affect welfare in an OLG framework and show that the way of financing is crucial. However, their model only distinguishes between credit and seignorage as government's sources of revenue, and not between different types of debt as we do. Mahdavi (2004) provides an empirical analysis on how the level of foreign government debt influences the composition of public spending. Using a sample of developing countries he finds rather mixed evidence on the effect of increasing external credit on productive and nonproductive government expenditure categories.

The voluminous literature on sovereign default has recently been surveyed by Augiar and Amador (2013) and Tomz and Wright (2013). Highlighting the large levels of domestic public debt, Reinhart and Rogoff (2011) argue that the literature's fixation on foreign debt may miss an important trigger of defaults and inflationary episodes. Broner and Ventura (2010) also question the prominent role of foreign debt by showing that the existence of secondary markets essentially erases the difference between external and internal public debt. By contrast, Drazen (1998) presents a model where differences between the costs of foreign and domestic debt reflect the respective political weights of creditors.[4] While domestic residents influence the government's choices through voting, external lenders are constrained to imposing a penalty in case of default. Drazen (1998) shows how the composition of debt, the budget deficit as well as the volume of government spending are determined by the political standing of the two types of creditors. However, he does not relate the government's financing decision to its decision on different types of spending.

2.3 The model

2.3.1 Households

In this section, we present a two-generation OLG model of a small open economy to explore how the profile of public expenses – i.e. the share of public investment and transfers – is related to the share of foreign debt in total public debt. In each period t, a young generation (born in period t) and an equally-sized old generation (born in period $t-1$) coexist. Individuals maximize their utility by choosing a consumption path for their remaining lifetime. The utility of an individual $j \in [0,1]$ living in period t and $t+1$ is given by

$$U_t^y(j) = C_t^y(j) + E_t C_{t+1}^o(j) \tag{2.1}$$

with C_t^y and C_{t+1}^o denoting consumption at young and old age, respectively, and E_t denoting conditional expectations. The use of a utility function that is linear in consumption and the assumption that the subjective discount factor equals one substantially simplifies the analysis.

[4] DiGioacchino et al. (2005) follow a similar approach, but in their model countries issue debt in a monetary union.

When choosing the utility-maximizing consumption path the individual has to consider the constraints

$$C_t^y(j) = Y_t + T_t^y - D_{t+1}^H(j) - (1 - \varphi_t)\zeta_t \tag{2.2}$$

and

$$C_{t+1}^o(j) = Y_{t+1} + T_{t+1}^o + \varphi_{t+1} R_{t+1} D_{t+1}^H(j) - (1 - \varphi_{t+1})\zeta_{t+1}. \tag{2.3}$$

In both periods, agents earn an income (Y_t, Y_{t+1}) and receive a transfer (T_t^y, T_{t+1}^o) from the government. Note that we assume that neither income nor transfers differ across members of a generation.

To implement his optimal consumption path, individual j spends the amount $D_{t+1}^H(j)$ on domestic government bonds, which represent the only store of value available to domestic agents. The real return on these bonds is given by R_{t+1}. Apart from selling bonds to domestic savers, the government may also borrow from foreign creditors. Every government bond has a maturity of just one period, i.e. has to be repaid in the next period.

We explicitly account for the possibility that the government defaults on its – domestic and foreign – debt. The binary variable φ_t captures this by taking the value of 1 if the government opts for repayment, and 0 if it decides not to honor its obligations. The latter case is associated with costs to all private agents currently alive, which are reflected by the parameter ζ_t.[5] We denote the probability of a default in period t by p_t.

Due to our assumption that utility is linear in consumption and that agents take the interest rate, the probability of default, and the government's transfer-schedule as given, expected returns on the market for government bonds have to satisfy the following condition:

$$(1 - p_{t+1})R_{t+1} = 1 \tag{2.4}$$

[5] These output losses could stem from a reduction in trade or financial market turmoil after a default. Borensztein and Panizza (2009) discuss the various costs that may be associated with a default.

If this condition holds members of the young generation are willing to save any amount up to their first-period disposable income. In what follows, we assume that they will, indeed, save the maximum amount, i.e.

$$D^H_{t+1}(j) = Y_t + T^y_t - (1 - \varphi_t)\zeta_t. \tag{2.5}$$

2.3.2 The Government

In every period, the government has to decide whether to default on its existing debt, how to finance government expenditure, and how to spend the funds it raised. Its objective is to maximize a political support function that takes into account the interests of both generations currently alive. While the default decision takes place at the beginning of the period, the financing and spending decisions take place simultaneously thereafter.

Whether the government decides to default on its debt in a given period depends on a comparison between benefits and costs. Of course, a default positively affects the government's budget, because the outstanding debt is not repaid. On the other hand, a default lowers the income of young and old residents in the same period. The extent of this reduction is given by the realization of the "default cost" variable ζ_t, which is drawn from a uniform distribution with support $[0, b]$ in every period. We assume that $b \leq Y_{t+k}$ for $k \geq 0$, which implies that the cost of default cannot exceed a generation's income. The setting of our model implies that the maximum default costs for the whole economy in one period are $2b$. Hence, b reflects the unconditional mean of economy-wide default costs. Note that, unlike in Eaton and Gersovitz (1981), a default has *no* consequences for a government's future access to international financial markets.

At the time the government decides on the volume and composition of its debt, it also chooses an expenditure profile. It can either spend its funds on transfer payments to the residents currently alive (T^y_t and T^o_t), or invest in the public capital stock K^G_{t+1}. Since we assume that public capital depreciates within one period, the capital stock in period $t+1$, i.e. K^G_{t+1}, coincides with public investment in period t. The latter enhances the income of both generations living in the following period, i.e. $Y_{t+1} = Y_{t+1}(K^G_{t+1})$. Finally, we assume that the government is not discriminating any generation via its transfer payments, i.e. $T^y_t = T^o_t = T_t$. Note that these transfers can also be negative.

Combining the assumptions described above, the period-t budget constraint of the government is given by

$$2T_t + K^G_{t+1} + \varphi_t R_t(D^H_t + D^F_t) = D^H_{t+1} + D^F_{t+1} \tag{2.6}$$

The LHS of this equation represents public expenses, which consist of public transfers T_t, public investment K^G_{t+1} and (possibly) the repayment of existing public debt $R_t(D^H_t + D^F_t)$, where D^F_t represents the stock of foreign debt due at the start of period t. The RHS represents the financing of these expenses via domestic and foreign debt issued in period t and to be repaid in period $t + 1$.

Combining (2.2), the government's budget constraint (2.6), and the assumption that young agents save their entire disposable income (2.5), we can derive

$$D^H_{t+1} = D^F_{t+1} + 2Y_t - K^G_{t+1} - 2(1 - \varphi_t)\zeta_t - \varphi_t R_t(D^H_t + D^F_t) \tag{2.7}$$

and

$$T_t = D^F_{t+1} + Y_t - K^G_{t+1} - (1 - \varphi_t)\zeta_t - \varphi_t R_t(D^H_t + D^F_t). \tag{2.8}$$

Expression (2.8) reflects an important finding: if the government repays its debt, this reduces the transfer a generation receives *by the same amount* although each generation gets only 50 percent of the government's total spending on transfers. This is due to a "multiplier"-like effect: debt repayment lowers the transfer to the young generation. The resulting decrease in income and savings reduces domestic demand for government bonds, which – through the government's budget constraint – further lowers the volume of transfers paid to both generations.

The government's objective function is a weighted sum of the utility of old and young residents alive. These weights reflect the relative influence of the old (ω) and the young ($1-\omega$) cohort in the domestic political process.[6] Thus, the government in period t maximizes

$$V_t^G = \omega C_t^o + (1-\omega)U_t^y \tag{2.9}$$

subject to the constraint (2.6).[7]

We start our analysis by considering the government's choice between default ($\varphi_t = 0$) and repayment ($\varphi_t = 1$). Having observed the realization of (potential) default costs ζ_t in period t, the government reneges on its debt if its objective function (2.9) without repayment takes a higher value than in case of repayment.

To analyze the government's decision, we substitute (2.1) – (2.3) into (2.9). Using the fact that $C_t^y = 0$ and substituting (2.8) into (2.3) we can formulate the condition that has to be satisfied for a government to strictly prefer default:

$$\begin{aligned}
&\omega\Big[2Y_t + D_{t+1}^{F,d} - K_{t+1}^{G,d} - 2\zeta_t\Big] + (1-\omega)E_t\Big[2Y_{t+1}(K_{t+1}^{G,d}) + D_{t+2}^F - K_{t+2}^G \\
&- \varphi_{t+1}R_{t+1}D_{t+1}^{F,d} - 2(1-\varphi_{t+1})\zeta_{t+1}\Big|\varphi_t = 0\Big] \\
&> \\
&\omega\Big[2Y_t + D_{t+1}^{F,nd} - K_{t+1}^{G,nd} - R_tD_t^F\Big] + (1-\omega)E_t\Big[2Y_{t+1}(K_{t+1}^{G,nd}) + D_{t+2}^F - K_{t+2}^G \\
&- \varphi_{t+1}R_{t+1}D_{t+1}^{F,nd} - 2(1-\varphi_{t+1})\zeta_{t+1}\Big|\varphi_t = 1\Big]
\end{aligned} \tag{2.10}$$

In (2.10), the subscripts d and nd refer to the decision to default (d) or not to default (nd).

[6] In defining the government's objective function, we thus follow the same approach as Song et al. (2012). A probabilistic-voting motivation of such a "political support function" is given in Coughlin and Murrell (1990) and further elaborated in Persson and Tabellini (2000).

[7] Obviously, old agents' utility is simply driven by their consumption level in the second (and last) period of their lives.

By using these subscripts, we allow for the possibility that the government's investment and borrowing choices in period t depend on its default decision. However, as we state in the following Lemma, such a relationship does not exist, and the choice between default and repayment in period t merely depends on a comparison between the exogenous costs of default (ζ_t) and the repayment burden on *foreign* debt.

Lemma 2.1. *The government decides to default on its debt if* $\zeta_t < \hat{\zeta}_t$, *with* $\hat{\zeta}_t = \frac{1}{2} R_t D_t^F$

The proof can be found in appendix A.

The key to understanding this result lies in the fact that the present and future volumes of domestic debt (D_t^H and D_{t+1}^H) appear on neither side of the inequality (2.10). This is because – as expressed by (2.7) and (2.8) – the repayment of domestic debt determines the size of the transfer that accrues to both generations: if the government chooses repayment, this lowers the transfers. If it defaults, transfers increase. Due to the "multiplier" effect through which any reduction in young agents' income is magnified, repayments and transfers completely cancel out, and the default decision becomes irrelevant for old agents' consumption.

To some extent, this extreme result is, of course, driven by our modeling choices – in particular the linearity of all payoffs. However, it highlights one of the key differences between domestic and foreign debt, which would also characterize models with more sophisticated specifications: domestic creditors are directly affected by the government's choice of tax and transfer schemes. Through the government budget constraint, these taxes and transfers are ultimately linked to the default vs. repayment decision. By contrast, foreign creditors are entitled to receive their repayment in full, and there is no way for the government to alter its net obligations unless it decides to default on its debt. Note that this result stands in contrast to the argument of Reinhart and Rogoff (2011) who claim that domestic debt is an important driver of outright or creeping default.

As stated in Lemma 2.1, the threshold value $\hat{\zeta}_t$ depends on the burden of repayment in period t. If the sum of principal and interest on (foreign) debt is high, the likelihood that ζ_t falls below the critical threshold is high as well, i.e. it is less likely that the government decides to repay its debt. Using the result from Lemma 2.1 and the assumption that ζ_t follows a uniform distribution on the interval $[0, b]$, we can derive the default probability p. For period $t+1$ this probability is given by

$$p_{t+1} = \frac{R_{t+1} D^F_{t+1}}{2b}. \tag{2.11}$$

The expression in (2.11) allows us to endogenize the interest rate on government debt R_{t+1}. External creditors are assumed to maximize the same utility function as domestic residents. This implies that – like domestic agents – they are willing to lend as long as the expected yield on government debt (accounting for the possibility of default) equals the constant risk-free return offered by international financial markets $R^* = 1$. Hence, the following condition has to be satisfied:

$$R_{t+1} = \frac{1}{1 - p_{t+1}} = \frac{1}{\left(1 - \frac{R_{t+1} D^F_{t+1}}{2b}\right)} \tag{2.12}$$

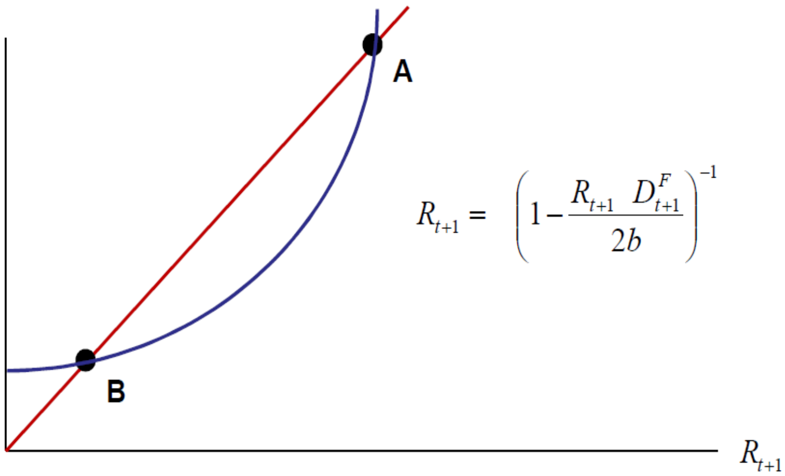

Figure 2.3: The interest rate on government debt in the presence of exogenous default risk

The equilibrium interest rate can be computed by solving the equation $R_{t+1} = \frac{D^F_{t+1}}{2b} R^2_{t+1} + 1$. Equation (2.12) is depicted in figure 3, with the LHS being represented by the 45-degree line and the RHS by a parabola.[8] Note that for a solution to exist we have to assume that $b \geq 2D^F_{t+1}$, i.e. the expected costs of default must be large enough. Moreover, the interest rate that solves (2.12) may not be unique. There may be an equilibrium that is characterized by a high probability of default and a high interest rate (point **A**) and another equilibrium that is characterized by a low probability of default and a low interest rate (point **B**). In what follows, we assume that lenders are able to coordinate on the low-interest rate equilibrium.[9] This implies that the equilibrium value of R_{t+1} increases in D^F_{t+1}, i.e. the more the government borrows abroad, the higher will be the price of debt, since the risk of default – the probability of the realization ζ_{t+1} being smaller than the threshold $\hat{\zeta}_{t+1}$ – is rising.

We now turn to the government's financing and spending decisions. Using the above results and the decision rule on default, the government's objective function can be expressed as follows:

$$\begin{aligned} V^G_t = \omega &\left[2Y_t(K^G_t) + D^F_{t+1} - K^G_{t+1} - \varphi_t R_t D^F_t - 2(1-\varphi_t)\zeta_t\right] \\ &+ (1-\omega)\Bigg[2Y_{t+1}(K^G_{t+1}) + D^F_{t+2} - K^G_{t+2} - D^F_{t+1} \\ &- 2\int_0^{\hat{\zeta}_{t+1}} \zeta_{t+1} dF(\zeta_{t+1})\Bigg] \end{aligned} \tag{2.13}$$

where $F(\zeta_{t+1}) = \frac{\zeta_{t+1}}{b}$ is the cumulative distribution function of ζ_{t+1}. The optimal values for public investment K^G_{t+1} and external debt D^F_{t+1} are implicitly characterized by the following first-order conditions:

$$\frac{\partial V^G_t}{\partial K^G_{t+1}} = -\omega + (1-\omega)2\frac{\partial Y_{t+1}}{\partial K^G_{t+1}} = 0 \tag{2.14}$$

and

[8] The solution to this equation is given by $R_{t+1} = \frac{b - \sqrt{b^2 - 2D^F_{t+1} b}}{D^F_{t+1}}$

[9] Note also that the equilibrium in point B is (locally) stable, i.e. starting from a point in the neighborhood of point B, the interest rate will converge to that equilibrium.

$$\frac{\partial V_t^G}{\partial D_{t+1}^F} = \omega - (1-\omega)\left[1 + \frac{2\hat{\zeta}_{t+1}}{b}\frac{\partial \hat{\zeta}_{t+1}}{\partial D_{t+1}^F}\right]$$
$$= \omega - (1-\omega)\left[1 + \frac{b - \sqrt{b^2 - 2D_{t+1}^F b}}{2\sqrt{b^2 - 2D_{t+1}^F b}}\right] = 0 \tag{2.15}$$

The conditions in (2.14) and (2.15) have straightforward interpretations: members of the old generation would like the government to increase transfers by reducing its investment expenditure and raising its foreign borrowing. By contrast, young agents are in favor of higher investment spending, since this raises their future income. Moreover, they realize that higher foreign borrowing raises future repayment obligations, which hurts members of the young generation since it reduces expected future transfers. This is also because higher foreign debt increases the likelihood of a default and thus expected future income losses. The weights ω and $(1-\omega)$ determine how strongly these conflicting interests affect the government's decision.

2.3.3 Government spending and public debt in equilibrium

We assume that agents' income is related to public investment through the following function: $Y_{t+1}(K_{t+1}^G) = A(K_{t+1}^G)^\alpha$, with A representing total factor productivity (TFP), which is assumed to be constant. We can substitute this functional form into (2.14) to derive the government's optimal investment expenditure:

$$\tilde{K}_{t+1}^G = \tilde{K}^G = \left(2\frac{1-\omega}{\omega}\alpha A\right)^{\frac{1}{1-\alpha}} \tag{2.16}$$

Equation (2.16) demonstrates that public investment $\tilde{K}^G$ is a constant. This is due to the stationarity of our model environment – there are no time-variant exogenous variables like, e.g., population size – and to our specific assumptions on the costs associated with default, namely, the fact that there is no persistent punishment of defaulting governments. Due to the young and old generations' distinct interests, $\tilde{K}^G$ is decreasing in ω, but increasing in $(1-\omega)$. Moreover, it is higher for higher values of the TFP parameter A.

Substituting this expression into the production function yields:

$$\tilde{Y}_{t+1} = \tilde{Y} = A^{\frac{1}{1-\alpha}} \left(2\frac{1-\omega}{\omega}\alpha \right)^{\frac{\alpha}{1-\alpha}} \tag{2.17}$$

The optimal value of foreign debt can be derived by solving (2.15) for D^F_{t+1}:

$$\tilde{D}^F_{t+1} = \tilde{D}^F = \frac{b}{2}\left(1 - \frac{1}{z^2}\right), \tag{2.18}$$

where $z \equiv \frac{2\omega}{(1-\omega)} - 1$. To guarantee that $\tilde{D}^F$ is strictly positive, we assume that $\frac{\omega}{1-\omega} > 1$, i.e. $\omega > 0.5$. Obviously, $\tilde{D}^F$ increases in b: if the expected costs of default are high, the probability of default is low even for high levels of foreign debt. This reduces expected income losses for the young generation and provides the government with an incentive to increase its foreign debt. It is also easy to show that $\tilde{D}^F$ is higher for higher values of z and thus ω: if the weight of the old generation in the political process gets higher, the government emphasizes current benefits at the expense of future costs and thus increases foreign borrowing.

Combining (2.12) and (2.18), we can derive the equilibrium interest rate on government debt $\tilde{R}_{t+1}$:

$$\tilde{R}_{t+1} = \tilde{R} = \frac{2z}{z+1} \tag{2.19}$$

In equilibrium, the interest rate charged by the government's creditors increases in z, which, in turn, increases in ω: a larger weight of the old generation in the government's objective function raises foreign borrowing, makes default more likely, and thus raises the interest rate charged by international and domestic lenders.

Since both $\tilde{R}_{t+1}$ and $\tilde{D}^F_{t+1}$ are constant, the threshold value $\hat{\zeta}_{t+1}$ is constant, too, and we have $\hat{\zeta} = \frac{b}{2}\left(1 - \frac{1}{z}\right)$. Using (2.11), (2.18) and (2.19) we can eventually derive the (constant) probability of default, which is given by:

$$\tilde{p} = \frac{z-1}{2z} \tag{2.20}$$

Using the above results and (2.7) we can calculate the volume of domestic debt in period $t+1$ for the case of default and for the case of repayment in period t:

$$\begin{aligned} \tilde{D}^H_{t+1}(\varphi_t = 0) &= 2\tilde{Y} + \tilde{D}^F - \tilde{K}^G - 2\zeta_t \\ &= \Lambda - 2\zeta_t \end{aligned} \tag{2.21}$$

with $\Lambda \equiv 2\tilde{Y} + \tilde{D}^F - \tilde{K}^G$ being determined by (2.16) – (2.18).[10] Note that $z > 0$ implies that $\Lambda > 0$.

$$\begin{aligned} \tilde{D}^H_{t+1}(\varphi_t = 1) &= 2\tilde{Y} + \tilde{D}^F - \tilde{K}^G - \tilde{R}(\tilde{D}^F + D^H_t) \\ &= \Lambda - 2\hat{\zeta} - \tilde{R}D^H_t \end{aligned} \tag{2.22}$$

Note that $\tilde{D}^H_{t+1}(\varphi_t = 0) > \tilde{D}^H_{t+1}(\varphi_t = 1)$ since $\zeta_t < \hat{\zeta}$ for the government to choose default and since $D^H_t \geq 0$. Hence, the volume of domestic borrowing in case of default is higher than in case of repayment.[11]

In equilibrium public transfers for both cases are given by:

$$\begin{aligned} \tilde{T}_t(\varphi_t = 0) &= \tilde{Y} + \tilde{D}^F - \tilde{K}^G - \zeta_t \\ &= \Pi - \zeta_t \end{aligned} \tag{2.23}$$

[10] Specifically, $\Lambda \equiv (2A)^{\frac{1}{1-\alpha}} \left(\frac{2\alpha}{1+z}\right)^{\frac{\alpha}{1-\alpha}} \left(1 - \frac{1+z}{2\alpha}\right) + \frac{b}{2}\left(1 - \frac{1}{z^2}\right)$.

[11] For a given value of D^H_t, the expected value of D^H_{t+1} is $E(D^H_{t+1}) = \Delta - D^H_t$, with $\Delta \equiv \Lambda - (1 - \frac{\tilde{p}}{2})\tilde{R}\tilde{D^F}$. Assuming that $D^H_0 = 0$, the expected level of domestic debt oscillates between 0 and Δ.

$$\begin{aligned}\tilde{T}_t(\varphi_t = 1) &= \tilde{Y} + \tilde{D}^F - \tilde{K}^G - \tilde{R}(\tilde{D}^F + D_t^H) \\ &= \Pi - 2\hat{\zeta} - \tilde{R}D_t^H\end{aligned} \tag{2.24}$$

with $\Pi = \Lambda - \tilde{Y}$. Following the same reasoning as above, one can easily see that $\tilde{T}_t(\varphi_t = 0) > \tilde{T}_t(\varphi_t = 1)$, i.e. by opting for default the government chooses a higher level of public transfers.

Using these results, we can compute the share of *external* debt in the total debt a government incurs at the end of period t. Denoting this share by $\tilde{s}_t$ and distinguishing between periods of default and repayment, we get

$$\tilde{s}_t(\varphi_t = 0) = \frac{\tilde{D}^F}{\tilde{D}^F + \tilde{D}^H_{t+1}(\varphi_t = 0)} := \frac{\tilde{D}^F}{\Omega_t(\varphi_t = 0)} \tag{2.25}$$

and

$$\tilde{s}_t(\varphi_t = 1) = \frac{\tilde{D}^F}{\tilde{D}^F + \tilde{D}^H_{t+1}(\varphi_t = 1)} := \frac{\tilde{D}^F}{\Omega_t(\varphi_t = 1)} \tag{2.26}$$

where $\Omega_t(\varphi_t = 0) = \tilde{D}^F + \Lambda - 2\zeta_t$ and $\Omega_t(\varphi_t = 1) = \tilde{D}^F + \Lambda - 2\hat{\zeta} - \tilde{R}D_t^H$. Since $\zeta_t < \hat{\zeta}$ for the government to choose default and since $D_t^H > 0$, the share of foreign debt in total debt is smaller in default periods than in repayment periods, i.e. $\tilde{s}_t(\varphi_t = 0) < \tilde{s}_t(\varphi_t = 1)$.

In a similar way, we calculate the share of *public investment* in total government expenditure in period t.[12] This variable, which we denote by $\tilde{q}_t$, is given by

$$\tilde{q}_t(\varphi_t = 0) = \frac{\tilde{K}^G}{\tilde{K}^G + 2\tilde{T}_t(\varphi_t = 0)} := \frac{\tilde{K}^G}{\Omega_t(\varphi_t = 0)} \tag{2.27}$$

[12] Note that if the government honors its debt, the repayment sum $\tilde{R}(\tilde{D}^F + D_t^H)$ is also part of its expenditures.

and

$$\tilde{q}_t(\varphi_t = 1) = \frac{\tilde{K}^G}{\tilde{K}^G + 2\tilde{T}(\varphi_t = 1) + \tilde{R}(\tilde{D}^F + D_t^H)} := \frac{\tilde{K}^G}{\Omega_t(\varphi_t = 1)} \tag{2.28}$$

with $\Omega_t(\varphi_t = 0)$ and $\Omega_t(\varphi_t = 1)$ being defined above. Since $\Omega_t(\varphi_t = 0) > \Omega_t(\varphi_t = 1)$, the share of investment in total public spending is lower in periods of default.

Combining (2.25) and (2.27) as well as (2.26) and (2.28), it is easy to show that, while the ratios $\tilde{s}_t$ and $\tilde{q}_t$ depend on a government's default decision and initial domestic debt in period t, the ratio $\gamma \equiv \frac{\tilde{q}_t}{\tilde{s}_t}$ does not. In fact, we have

$$\gamma(A, b, \omega) = \frac{\tilde{K}^G}{\tilde{D}^F} \tag{2.29}$$

Equation (2.29) suggests a positive relationship between $\tilde{q}_t$ and $\tilde{s}_t$, with the factor of proportionality (γ) depending on the parameters A, b, and ω.
Apparently, γ increases in A since a higher productivity of government spending raises $\tilde{K}^G$. The factor γ decreases in b since higher expected costs of default make it more attractive to borrow abroad and thus raise $\tilde{D}^F$. Finally, γ decreases in ω, which represents the political weight of the old generation: this weight has a negative impact on investment spending $\tilde{K}^G$ and a positive effect on foreign borrowing $\tilde{D}^F$, and thus makes the ratio γ decrease.

This result has two important implications: First, it delivers a theoretical explanation for the *positive* correlation suggested by figure 2.2. Governments that spend relatively more of their budget on public investment tend to issue relatively more of their debt abroad and vice versa. The reason is that both decisions are shaped by the three economic and political fundamentals we identify in our model and that the parameter which links those decisions (γ) is strictly *positive*. Second, the expression in (2.29) also explains why the relationship between the composition of government debt and the structure of public spending is not very strong: a change in any of the parameters that determine s and q also affects γ, i.e. the factor of proportionality that links the two shares. An empirical test of our theory would have to account for this non-linearity. Moreover, it would have to control for other factors that potentially determine the real-world counterparts of q and s. This, however, would be beyond the scope of the current analysis.

2.4 Conclusion

Our goal was to explore the relationship between the structure of government debt and the composition of public expenditure. This project was based on the notion that the spending decisions affect the financing decision through its influence on the availability of domestic savings, while the financing decision determines the potential volume of transfers, but also the risk of sovereign default.

To achieve this aim, we developed a simple model that incorporated some of the important distributional trade-offs faced by a political-support maximizing government. In particular, by explicitly allowing for the possibility of government default, we captured one of the key differences between domestic and foreign debt: unlike foreign creditors, domestic holders of public debt are directly affected by the government's choice of taxes and transfers, which may partly (or completely) undo the losses inflicted by debt repudiation. While our extreme result that domestic debt is *completely irrelevant* for the government's default decision is certainly due to our modeling strategy – in particular, the linearity of agents' objective functions – we observe that this fact reflects a fundamental difference between internal and external debt that is relevant even if a defaulting government cannot discriminate between domestic and foreign creditors. The special role of foreign debt makes the government's financing decision non-trivial: while increasing foreign borrowing allows to increase transfers to the generations currently alive, it also raises the future repayment burden. Moreover, a higher debt level raises the likelihood of default and thus expected future income losses. The latter effect is the stronger the lower the maximal cost of a default. As a consequence, countries in which a government default would potentially cause huge output losses and in which the old generation has a strong political weight should see their governments incur rather high levels of external debt. As far as the spending decision is concerned, the old generation favors spending on transfers while the young generation emphasizes the positive effects of public spending on future income. Again, the government's decision ultimately depends on the relative political weight of the two generations. The contribution of this chapter is to highlight the mutual dependence between the government's spending and financing decisions and to detect the fundamental forces that shape the government's simultaneous choices.

Our analysis offered a theoretical explanation for the positive correlation we observed in figure 2.2 by identifying a – certainly non-exhaustive!– list of parameters that affect the government's spending and financing choices. Furthermore these parameters also account for at least a part of the observed cross-country heterogeneity in government's decisions. While our aim was to provide a theoretical idea why public expenditure composition and debt structure are linked, the empirical test will be covered by the following chapter. We believe, however, that our analysis paves the road for a deeper understanding of the forces that shape government borrowing and spending behavior and, ultimately, financial stability.

3 Foreign vs. domestic public debt and the composition of government expenditure: The empirical approach

3.1 Introduction

The previous chapter has explored new avenues by investigating the link between policymakers' simultaneous decisions about where to borrow (domestically vs. abroad) and how to spend the acquired funds (public investment vs. consumption). An OLG model helped to identify three main country characteristics that shape both of these decisions. The aim of this chapter is to empirically test whether the total factor productivity (TFP), the possible maximum default costs, and the age structure of a nation show the theoretically predicted effects on the public borrowing as well as the spending decision. Additionally, also the factor that links both choices – i.e. γ – should be shaped by the above mentioned country characteristics. Therefore, I assembled a new dataset containing information about the financial structure as well as the expenditure profile of (in the narrowest version) 29 countries.

For the analysis I first derive the marginal effects of the three main country characteristics. As it turns out, the impact of the TFP (A), possible maximum default costs (b), and the relative size of the older cohorts (ω) affect the two key quotas of chapter 2 diametrically:

The share of public investment in total government expenditure q is higher in more pro-

ductive countries. At the same time this share is lower if there is more to lose in case of default (i.e. higher b) and if the older cohorts are relatively large (i.e. large ω).
For the ratio of foreign to total debt s it is just the other way around: highly productive nations issue relatively less debt abroad, while high default costs as well as a large share of old residents result in relatively high foreign debt quotas.
As the intention of the previously described theoretical model is to investigate the relationship of q and s it links these ratios via the construction of γ, which is then also determined by the three main country characteristics. The marginal effects of A, b, and ω are – due to the design of γ – the same as for q.

The empirical validation of these effects then shows, that especially the total factor productivity and a nation's age structure make major contributions to explain variation in how policymakers distribute expenditure and where they issue public debt. Furthermore, also the link between those two decisions (γ) is positively influenced by the TFP and negatively by the relative size of older cohorts.

In addition to that the data also reveal that the marginal effects derived in the theoretical model describe the governmental behavior of *advanced* countries best. Whereas for the upper and lower middle income countries in the sample the impact of A and ω is not significant, the two coefficients strongly support the positive (A) and negative (ω) influence from theory for the subsample of rich nations.

The remainder of this chapter is structured as follows: section 3.2 reviews empirical studies on either the public spending or the public debt decisions. In section 3.3 I describe the construction of the dataset, before I turn to the empirical investigation in section 3.4. The last section concludes.

3.2 Literature

Empirical studies linking government debt and expenditure are not novel, but rather rare. Most of the literature deals with hypothesis on either public debt or spending issues.

Regarding the former the distinction between internal and external debt has recently gained more attention. Studies like Reinhart and Rogoff (2011), that trace the evolution of domestic borrowing back to the nineteenth century, or Panizza (2008) by displaying trends in the composition of public debt in developing countries, have been widely noticed since they constructed large datasets separating domestic and external debt figures.[1] Following up, a variety of papers investigates the nexus of economic growth and either foreign or domestic debt shares. Abbas and Christensen (2010) detect several channels how moderate levels of internal debt enhance growth in low income countries (LICs) and Emerging Markets (EMs).[2] However, their analysis is based only on bank holdings of domestic debt and neglects non-banking institutions, possibly biasing their results. Nevertheless, their findings are confirmed for LICs' total domestic debt by Presbitero (2012). For the impact of external debt on growth, building on a large literature in the past quite a few recent authors are aiming to detect a threshold for a positive effect. Presbitero (2008) as well as Pattillo et al. (2011) find this brink at a level of 30 to 40% of foreign debt over GDP, while Imbs and Ranciere (2005) and Cordella et al. (2005) locate it between 10 and 20%. These studies mainly analyze data for developing and/or LICs, respectively.

Closest to this work are Forslund et al. (2011). Their hypothesis is – as well as mine – that the government's decision on issuing debt at home or abroad can be explained by a country's macroeconomic characteristics.[3] In a sample of roughly 100 developing countries they test the impact of a large set of controls representing macroeconomic stability, economic development, banking crisis and defaults, and openness of a country on the share

[1] Another dataset focusing on the structure of domestic debt in emerging market countries with regard to maturity, foreign currency denomination, and indexation together with the risks that emerge from shifts in these three categories is provided by Mehl and Reynaud (2010).

[2] In particular, they find a positive impact of domestic debt issuance on the national capital markets therewith allowing for more and riskier private investment and thus fostering growth. Additionally, the institutional environment shows up as a crucial factor for a growth enhancing effect of domestic debt.

[3] This builds upon previous studies by Claessens et al. (2007) and Borensztein et al. (2008) that assess the determinants of domestic government bonds. They also find that country characteristics as for instance country size, institutional quality or trade openness play an important role.

of domestic in total public debt. However, the empirical evidence is rather poor and they are not including the three main characteristics we detected, also lacking to be backed up by a theoretical model.

Turning to the public spending literature early papers on the composition highlighted shifts from capital expenditure (Hicks and Kubisch (1984), Hicks (1991)) to transfer payments (Heller and Diamond (1990)) for various country samples in the 1970s and 1980s. These shifts have then been analyzed mostly regarding their importance for economic growth. Devarajan et al. (1996) show that developing countries could enhance economic growth by shifting from public capital to consumption expenditure, since the former are used excessively and therewith marginally less productive than the latter. In the same line Cavallo and Daude (2011) find that public investment crowds out private investment and lowers economic growth in developing countries. This effect is moderated by country characteristics like a strong and reliable institutional environment, access to the international financial markets or participation in world trade. The converse view is supported for instance by Acosta-Ormaechea and Morozumi (2013) who find empirical evidence for 56 countries that public investment is indeed growth enhancing at the expense of especially social and educational spending. Furthermore, Kneller and Misch (2014) find a robust positive effect of compositional shifts towards investment-related expenditure for the productivity of firms, but their analysis is based only on data for South African provinces. However, lowering productive expenditure in favor of public transfers might also not be a panacea. As Creedy and Moslehi (2009) show for 24 countries, this policy would result in an increase in income inequality.

A second strand of literature identifies these shifts or the composition of government expenditure itself as caused by political-economic reasons. Persson and Tabellini (2005) shed light on the strategic use of public expenditure in order to influence the outcome of a vote. This view is confirmed by Drazen and Eslava (2010) who state that it is rather the composition than the level of government spending that causes political support for an incumbent government. Finally, Darby et al. (2004) draw the line from political-economic considerations to the growth aspect of public expenditure. They analyze a panel of OECD countries and argue that political instability within governments is likely to lower their reelection probability. This, in turn, deters the officeholders from starting mid- and long-term investment projects and thus reduces economic growth.[4]

However, all of these studies are lacking the link to the government's financing decision. Papers that do relate debt and expenditure are rather rare. Exceptions are Lora (2007) and Lora and Olivera (2007). The former finds evidence for a small but robust positive effect of public debt on public infrastructure investment in seven Latin American countries.[5] His conjecture is that expenditures on infrastructure are rising more than other types of public spending because of mainly political reasons: governments initiate these projects because they are more widely accepted as an adequate use of newly acquired funds since they are promising at least short and medium term returns. Looking at non-productive government spending Lora and Olivera (2007) investigate the impact of public debt on public social expenditure. In line with Lora (2007) their analysis reveals a strong negative effect of the public debt burden. Somewhat surprisingly, this occurs not so much due to a shift from social expenses to interest payments, but due to the fact that higher debt levels leave less room for future debt increases, which are associated with even more spending cuts. But although both studies link government expenditure and financing, they do not distinguish between internal and external debt as I do.

Closest to this chapter is the work by Mahdavi (2004) that inquires into the effects of foreign debt on various expenditure categories. In a sample of about 50 developing countries he finds rather mixed empirical evidence for the period from 1972 to 2001. One the one hand public capital expenditure is negatively influenced by an increase in external debt in most but not all of the (sub)samples.[6] On the other hand the results for "current type expenditures" are quite ambiguous, since two subcategories are affected in opposite directions.

Altogether, there is an all but clear picture on the link of foreign debt and public spending.

[4] Alternatively, Hessami (2010) focuses on the domestic resident's well-being in the form of life satisfaction and finds positive effects of shifts from social protection to educational spending for twelve EU countries.

[5] According to the author, a debt increase of 1 dollar results in a 1 cent surge in public investment in the current and 1.4 cent in the following year.

[6] This view is supported by Clements et al. (2003). For 55 LICs they detect rather debt service payments than the debt burden itself as a negative driver of public investment.

3.3 Getting the data

Data on the composition of government debt have just recently emerged when the distinction between external and internal obligations gained some more attention in the theoretical literature. Among the first to assemble such data have been Guscina and Jeanne (2006). Their panel covers 19 Emerging Market countries, whereas Cowan et al. (2006) consider 23 (Latin) American and Fouad et al. (2007) 19 Middle East Countries, respectively. However, the focus of all these datasets is strongly on the developing world. Data on a by far wider range of countries are presented by Panizza (2008). He gathers figures on internal and external debt for around 130 countries from roughly 1990-2005. In this work, I basically use this dataset but extend it with respect to time by employing recent data from the IMF's *Quarterly Public Sector Debt Statistics* and an updated version of the Cowan et al. (2006) database. Consequently, as in Panizza (2008) also my dataset is focusing on central government debt. Only when this figures are not available, I rely on general government debt data rather than having no observations.

The coverage of data on government expenditure that is publically available is quite good. The main source of detailed information on the structure of public expenses are the IMF's *International Financial Statistics*, following the *Government Finance Statistical Manual* (GFSM). However, the spending categories of the GFSM do not allow to directly asses a government's investment disbursements. Therefore, I use the more accurate measure of public gross fixed capital formation from the OECD, the European Central Bank and, to fill in the gaps, the World Bank's *World Development Indicators* (WDI). For the public transfer variable I rely on figures on social benefits from the IMF's *World Economic Outlook*. Unfortunately, both of the latter variables are just available at the general government level. While I don't expect this to distort the results significantly, one should keep in mind this bias for the interpretation of the findings. Additionally, for these two variables the coverage is not as good as for the debt data, thus limiting my dataset to a smaller sample.

For the country characteristics that have been derived in chapter 2 to explain the foreign debt as well as the public investment quota, I assemble data from several sources: first, the political power of the old generation ω will be measured by the *WDI*'s "age dependency ratio, old". Second, the possible costs for a government to bear in case of a default (b) are a counterfactual. Therefore, I use the market capitalization of listed domestic companies from *Standard & Poor's Global Stock Markets Factbook* as well as from the *World Federation of Exchanges* as a proxy, indicating how much a country has to lose in case of a strategic default[7]. This, of course, only makes sense if I use this figure scaled by GDP. Finally, as a measure for the productivity of a country, I employ the Total Factor Productivity variable from Daude and Fernandez-Arias (2010). They calculate TFPs using a Cobb-Douglas production function including human capital for about 75 countries. However, since in the model the only factor of production is capital, one can also interpret the parameter A as the productivity of only this factor. Hence, I'm using data about GDP and the capital stock form the *Penn World Tables* to calculate a measure ($Capprod\_pub$) for this alternative interpretation of A.

Bringing together data from all these sources, I'm using an unbalanced panel of (in the narrowest sample) 29 countries[8] that roughly covers the period 1990-2010. A list of the applied variables and their sources, respectively, can be found in table b.2 in the appendix.

3.4 Public debt and expenditure

In this section, I empirically investigate the effects of the model's three main characteristics (i.e. the productivity of a country A, its vulnerability in case of default b, and its demographic structure ω) on a government's spending behavior and its debt profile. However, before I start with the empirical analysis I derive the marginal effects of these characteristics on the public investment quota q and the foreign debt quota s, which I will validate with the new dataset thereafter. The following table gives an overview.
The mathematical way to derive these effects is shown in appendices B.1.1 and B.1.2. As one can easily infer from table 3.1 the government's decision whether to repay its debt

[7] Recall that the theoretical model as well as this chapter are just about the willingness and not the ability of governments to meet their debt obligations.
[8] See footnote 28 for a list of these nations.

Variable	A	b	ω
$\tilde{q}_t(\varphi_t = 0)$	+	-	-
$\tilde{q}_t(\varphi_t = 1)$	(?)	-	(?)
$\tilde{s}_t(\varphi_t = 0)$	-	+	+
$\tilde{s}_t(\varphi_t = 1)$	-	+	+
γ	+	-	-

Table 3.1: Signs of the marginal effects of A, b, and ω

($\varphi_t = 1$) or declare a default ($\varphi_t = 0$) does not influence the direction of the marginal effect of the key country characteristics on either q or s.[9] Moreover, also γ is by construction independent of the default decision (cf. equation (2.29)).[10]

Additionally, table 3.1 shows that the public investment behavior and the relative size of the foreign debt stock are influenced by the country characteristics in exactly the opposite way. The reasons for these effects will be discussed below.

In chapter 2 the main variable of interest is γ. However, since γ is defined as the ratio of a government's investment expenditure share (q) and it's external debt quota (s), I start this evaluation by assessing the impact of A, b, and ω on both of these quotas separately before I turn to the impact on the combined measure γ.

The model I am estimating is a log-linearized version of the equilibrium values of q, s, and γ, respectively (see equations (2.25) through (2.28)):[11]

$$\ln Q_{i,t} = \beta_0 + \beta_1 \ln A_{i,t} + \beta_2 \ln b_{i,t} + \beta_3 \ln \omega_{i,t} + \delta \ln X_{i,t} + \epsilon_{i,t}, \qquad (3.1)$$

where A, b, and ω are the country characteristics that are theoretically detected as the key

[9] The only exception being the public investment quota in case of repayment $\tilde{q}_t(\varphi_t = 1)$ (cf. appendix B.1.1).

[10] Thus, controlling for default in the later regressions should show an insignificant coefficient. However, since the only default (as measured by Sturzenegger and Zettelmeyer (2007)) that would enter the regressions is the one of Uruguay in 2003 (remember that data availability limits the sample size with respect to countries as well as periods), the interpretation of the result could not be generalized. Having checked that the coefficients of the other explanatory variables do not change considerably by adding this dummy, I drop it in the following analysis.

[11] Replace *lnQ* by *lnS* and *lnGamma* for the functional form of the latter regressions.

drivers of the dependent variables, and X is a set of macroeconomic control variables.[12] The main results will be derived using fixed effects estimators that capture to what extent within-country variation in A, b, and ω can explain differences in the spending behavior as well as the debt profile of a government. I also cluster the standard errors in order to account for heteroskedasticity.

Looking at the determinants of a government's expenditure pattern (q) first, table 3.2 already delivers some insights:

(i) The positive effect of the TFP ($lnA1$) that is predicted by the model can also be seen in the data. Especially in the large specification (column 5), this variable shows a strongly positive and significant impact (at the 5%-level) on the share of public investment in public expenditure.[13] Thus, the more rewarding public investment projects are, the relatively more does the government spend on it.

(ii) For the vulnerability in case of a default ($lnMacap$) the results are rather poor. There is no significance in neither specification (columns 2, 4, and 5), and accounting for other controls than the three country characteristics turns the coefficient even positive. This is not in line with the theoretical prediction which would suggest lower public investment quotas for countries that have to lose more in case of default.

(iii) However, the β for the age structure of a society ($lnAdr$) is strongly in favor of the theory. Throughout all of the specifications (columns 3, 4, and 5) this variable exhibits a significantly negative impact on lnQ, indicating that governments facing older voters spend relatively more on public transfers.[14] The reason is simply that for older cohorts it is more likely to not participate in the future profits of today's investment expenditure and therefore they push the government into the direction of unproductive expenses.

In column 5 I add a set of control variables that might theoretically also affect the government's decision on how to spend its funds:[15]

[12] The subscripts i and t denote country and time, respectively.

[13] The scant (and even negative) result in the first column is most likely caused by omitted variables, whichs' effects are soaked up by the coefficient of A.

[14] Similar results are derived by Jäger and Schmidt (2015) who find a negative influence of aging on the level of public investment for 13 OECD countries.

[15] Although there might be reasons to in- or exclude one or another variable, table 3.2 as well as the later tables show, that the set of controls I choose adds a substantial share of explanatory power in the

	(1)	(2)	(3)	(4)	(5)
	lnQ	lnQ	lnQ	lnQ	lnQ
	b/se	b/se	b/se	b/se	b/se
lnA1	-0.031			0.463*	1.158**
	(0.41)			(0.27)	(0.44)
lnMacap		-0.028		-0.039	0.015
		(0.03)		(0.04)	(0.04)
lnAdr			-0.794***	-1.312***	-1.267***
			(0.22)	(0.25)	(0.27)
lnGdpPc					-0.419*
					(0.23)
lnGvtExp					0.307
					(0.21)
lnInst					0.074
					(0.20)
lnDebt					-0.045
					(0.06)
lnGvtBal					0.044*
					(0.02)
lnTaxRev					-0.137
					(0.13)
lnInfl					0.024
					(0.03)
lnSavingR					0.077***
					(0.02)
lnDepr					0.182
					(0.36)
lnCaBal					-0.041**
					(0.02)
lnTrade					0.056
					(0.16)
_cons	-1.114	-1.492***	-2.839***	-6.709***	-7.727***
	(2.44)	(0.03)	(0.44)	(1.82)	(2.65)
R^2	0.000	0.005	0.064	0.216	0.339
Observations	541	799	1065	440	292
Countries	44	62	81	37	31

* p<0.1, ** p<0.05, *** p<0.01

Table 3.2: Public investment quota and TFP, FE

First, variables that capture the size and economic development of a country feature the expected signs but with rather poor significancies. Whereas (economically) larger coun-

regressions, but at the same time rather few of these variables show significant coefficients. Nevertheless, I also operated with a larger amount of controls (adding e.g. controls for capital openness, financial repression, political change, private investment, exchange rate fluctuations, private debt etc.), which – albeit reducing the sample size due to data non-availability – did not change the results shown here considerably. Therefore, a reduced set of control variables seems to be suitable in this analysis.

tries – indicated by high per capita output (*lnGDPpc*) – exhibit a relatively low share of public investment, countries that have a large public sector (i.e. high government expenditure/GDP – *lnGvtExp*) use relatively more of their funds for investment-related purposes. Also the institutional quality (*lnInst*) seems to foster q.
Turning to the funds that a government can use for expenditures, a large stock of debt (*lnDebt*) prevents policymakers from (relatively) high investment expenses, while a positive government balance relative to GDP (*lnGvtBal*) seems to promote the latter. The interpretation is straightforward: if there is more (financial) room for governments, investment related expenditure gains in importance.[16] However, the negative sign of the tax revenues relative to GDP (*lnTaxRev*) would non-significantly oppose this view.
For the variables covering macroeconomic aspects that are not under direct control of the policymaker I only find strong significancies for the saving rate (*lnSavingR*). The channel through which this positively affects q might be that the public authorities are competitors of private investors in acquiring these savings for investment purposes and therefore spend these funds relatively less on public consumption. The coefficients for inflation (*lnInfl*) and the depreciation rate (*lnDepr*) show the counterintuitive signs (both are positive) but are also far from being significant. However, using the lagged values[17] of these two variables, I find at least a negative impact of both (cf. table b.4 in the appendix) albeit the coefficients remain close to 0.
Last, the openness of a country might influence the government's choice between investment and transfers: And indeed, the current account balance relative to GDP (*lnCaBal*) shows a negative and significant effect. This might be explained by the fact that countries attracting a lot of foreign funds create a climate for investment that also boosts the relative size of public investment expenses. For trade openness (*lnTrade*), however, there is no significant impact on q.

Note that the use of the controls limits the sample to 31 countries and 292 observations. However, repeating the regressions (1) through (4) with the small sample of regression (5) does not substantially alter the results (cf. table b.3 in the appendix).

[16] This is also supported by the positive effect of *lnGvtExp*.
[17] See below for more information on the use of lagged values.

One might question that q, s, and also γ are results of a policymakers decision in a certain period, and therefore the knowledge the latter has about the (macro)economic variables, that potentially influence his decision, is constrained to values of previous periods (that may be just interpreted by the government as a good proxy for the current period). Hence, I should rather include the lagged values of the explanatory variables in the regressions of table 3.2.[18] Except for minor changes in the coefficients of non-significant variables table b.4 in the appendix shows that the major results do not change with this feature. Therefore, I stay with the current values of the controls in the following analysis of s and γ.

As mentioned earlier, the model also gives room for the interpretation of A as the productivity of only (public) capital. In table 3.3 I replaced the TFP measure by *lnCapprod_pub* that captures how much output in a country is generated by one unit of public capital. Although the predicted effects from the model are the same as for the TFP, the empirical results show the opposite, i.e. a negative impact of public capital productivity on q. There are two potential reasons for this rather surprising result:

First, the negative effect may be caused by the construction of the *capprod_pub* variable: since there is a lack of data on the public capital stock, I assume that the total capital stock of the economy is divided into private and public capital by the same ratio as its change, i.e. investment.[19] However, this construction gives room to some bias: for instance a country that had a lot of private investment in the past and therefore a large share of the capital stock is in private ownership nowadays could exhibit a large share of public capital in the dataset just because today's public investment share is large. This would lead to lower values for the *capprod_pub* measure. However, since the final sample for the regressions in table 3.3 comprises mostly advanced economies[20] I expect the bias to be exactly the opposite. These nations show an average share of public in total investment of 12.1% in 2009 which was much higher a decade ago (17.5% on average in 1995). Thus, the overall public capital share should be biased towards to low figures, which in turn leads to an overestimation of public capital productivity.

[18] This also helps to cope with potential reverse causality issues.
[19] In mathematical terms this reads: $K^{pub} = \frac{Inv^{pub}}{Inv^{pub}+Inv^{priv}}K$.
[20] 30 of the 45 countries in column 5 are high income countries.

	(1) lnQ b/se	(2) lnQ b/se	(3) lnQ b/se	(4) lnQ b/se	(5) lnQ b/se
lnCapprod_pub	-0.279***			-0.405***	-0.557***
	(0.08)			(0.08)	(0.08)
lnMacap		-0.028		0.051*	0.007
		(0.03)		(0.03)	(0.02)
lnAdr			-0.794***	-1.120***	-1.235***
			(0.22)	(0.23)	(0.41)
lnGdpPc					0.465***
					(0.17)
lnGvtExp					-0.103
					(0.18)
lnInst					-0.233**
					(0.11)
lnDebt					-0.224***
					(0.05)
lnGvtBal					0.070***
					(0.02)
lnTaxRev					0.066
					(0.11)
lnInfl					0.043***
					(0.01)
lnSavingR					0.179***
					(0.03)
lnDepr					0.216
					(0.42)
lnCaBal					-0.044***
					(0.01)
lnTrade					-0.014
					(0.12)
_cons	-1.089***	-1.492***	-2.839***	-3.225***	-6.265***
	(0.05)	(0.03)	(0.44)	(0.39)	(2.08)
R^2	0.201	0.005	0.064	0.348	0.613
Observations	1019	799	1065	784	412
Countries	77	62	81	60	45

* p<0.1, ** p<0.05, *** p<0.01

Table 3.3: Public investment quota and public capital productivity, FE

Second, the model's focus is not on the economy's production process and therefore neglects all factors of production other than public capital. Thus, I would have to control for the effects of labor, human capital, private capital etc. to really get the pure impact of public capital productivity on q. However, data availability limits this attempt.

Summing up, the effect of public capital productivity on the public investment share is negative. This result is surprising, but should be treated with caution, since there are issues that might bias the *capprod_pub* measure by construction. Therefore, the TFP variable seems to be the more reliable measure and I will thus use this interpretation of A primarily in the following analysis.

Nevertheless, for the other two key characteristics, I find the same evidence as with the TFP measure in table 3.2, i.e. almost no effect for $lnMacap$ and a clearly negative impact for the age structure ($lnAdr$).

Turning to the policymaker's decision on where to issue debt[21], I also test whether the variables I used in table 3.2 can explain variations in the external debt quota s:

The results for this measure (see table 3.4, column 5) are again mostly in line with the predictions from the theoretical model: there is a strong and significant effect of TFP, indicating that more productive countries rely relatively more on domestic debt (i.e. low s). As described above this effect occurs, because a higher TFP generates higher income which leads to higher domestic debt demand of households.

As for q also for the debt decision the effect of possible default costs ($lnMacap$) is close to 0 and does not show the expected sign. The model would have proposed a positive impact of higher default costs on the size of the external debt share, since a higher vulnerability in case of default would simply make that very event less likely to occur. In turn, foreign debt becomes less expensive (or – as it is in equilibrium in the model – the international lenders provide more credit) and therewith more attractive for a government seeking for funds.

Concerning the age structure of a society ($lnAdr$) I find the – albeit insignificant – positive effect on s that is predicted in chapter 2. Since older cohorts do not care about repayment of foreign debt, an increased size of their age group induces countries to expand their foreign liabilities relative to domestic debt.

Adding the set of control variables – which again reduces the sample size – raises the

[21] Note that the theoretical model allows to read D^F as the stock of foreign debt or the newly issued foreign debt within a period, respectively. Thus, figures on the external debt stock also comprise previous government's decisions on where to borrow. In the model, this is not an issue, because there is no political turnover. In fact, if I use the scarce data I have on the composition of governments for 36 OECD countries this does not alter the results of the following regressions but drives down the sample size dramatically. Therefore, I do not make further use of this variable. Alternatively, I generated the figures of newly issued external and domestic debt out of the stock values (which also incorporates valuation effects, of course). Regressing these values on the country characteristics, however, does not deliver significant results at all. Thus, the interpretation of D^F as the stock of foreign debt does empirically have a better foundation.

	(1)	(2)	(3)	(4)	(5)
	lnS	lnS	lnS	lnS	lnS
	b/se	b/se	b/se	b/se	b/se
lnA1	-0.778**			-0.715	-2.962***
	(0.36)			(0.50)	(0.91)
lnMacap		-0.077***		-0.004	-0.032
		(0.03)		(0.04)	(0.05)
lnAdr			-0.412	-0.684	0.570
			(0.41)	(0.72)	(1.04)
lnGdpPc					0.766
					(0.50)
lnGvtExp					0.108
					(0.18)
lnInst					-0.506**
					(0.23)
lnDebt					-0.259*
					(0.13)
lnGvtBal					0.086*
					(0.05)
lnTaxRev					-0.768***
					(0.25)
lnInfl					0.103**
					(0.05)
lnSavingR					-0.006
					(0.03)
lnDepr					-0.634
					(0.71)
lnCaBal					-0.013
					(0.03)
lnTrade					0.143
					(0.27)
_cons	3.607*	-1.053***	-1.718*	1.675	7.521*
	(2.07)	(0.04)	(0.95)	(3.73)	(4.43)
R^2	0.026	0.021	0.006	0.039	0.230
Observations	1120	1351	2056	888	432
Countries	71	100	134	63	48

* p<0.1, ** p<0.05, *** p<0.01

Table 3.4: Foreign debt quota and TFP, FE

share of variation in s that can be explained ($R^2 = 0.23$) distinctly, but this surge is mainly attributed to five of the measures, while most of the controls are not significantly different from 0. Not surprisingly, the measures capturing the government's fiscal position are highly relevant for the decision about where to issue debt. As one would expect

a larger debt stock (*lnDebt*) is an obstacle for external borrowing while a positive fiscal balance (*lnGvtBal*) promotes foreign debt accumulation. Additionally, if the policymaker is capable of generating large tax revenues (*lnTaxRev*), there is simply less need to raise funds externally. The two remaining control variables that influence s significantly are the institutional quality (*lnInst*) and inflation (*lnInfl*), respectively. The latter's positive effect might well stem from the fact that high inflation comes along with lower domestic debt levels, because it increases the government's costs for newly issued internal debt[22]. This will, in turn, drive up s. Concerning *lnInst* the negative impact might be surprising at first glance. But a lower external debt quota for countries with better institutional quality just tells us, that the latter is simply more important for the issuance of domestic than foreign debt. In general, the results for these five significant determinants of s are the same that Forslund et al. (2011) detect in their study about the causal effects of macroeconomic variables on the share of domestic debt.
Summing up, I do find some support for the effects the model predicts for the three key characteristics. Especially the negative impact of productivity is very prominent. While b and ω do not show significant effects, the results for the significant controls are in line with previous research on domestic debt.

In order to account for reverse causality issues[23] I also run these regressions with lagged values of the explanatory variables (see table b.5, column 2 in the appendix). As in the case of q the results do not change substantially for the foreign debt quota which makes the findings in table 3.4 quite robust.[24]

The rather weak results in columns 1 through 4 of table 3.4 in terms of significance and explanatory power do not change, if I limit the sample size to countries that are used for the large specification in column 5 (see table b.6).

I also check whether the use of the alternative interpretation of A as productivity of

[22] Cf. Forslund et al. (2011) and Claessens et al. (2007) who also find evidence for this effect.
[23] Note that the data on public debt are end-of-year values but reflect the government's decisions during the year. Thus, these decisions might rather be based on the country characteristics' values of the previous year.
[24] The signs of the coefficients of *lnMacap* and *lnAdr* are switching for the lagged values, but both remain insignificant anyway. Furthermore, *lnGvtBal* and *lnInfl* lose in significance.

public capital could deliver further insight, but the significancies are rather poor with only 10% of the foreign debt quota's variance being explained by the full set of variables (cf. table b.7 in the appendix).

However, the aim of this chapter is to empirically shed light on the joint determination of public expenditure and debt. In the theoretical model this was condensed in the construction of γ as the ratio of q and s. I will continue with the analysis of γ in the next section. Before that I will shortly focus on another aspect of the joint government's decision: in addition to the country characteristics that have been identified as the main drivers of q and s above, one might argue that there could be other effects that jointly influence the policymakers choice of where to issue debt and how to spend these funds. For instance, think of supply and demand effects of domestic debt in the way that public investment projects that do not have broad support in the resident's appreciation might induce the latter not to buy their government's debt[25], which would result in a larger foreign debt share.
I account for such effects using the seemingly unrelated regressions approach that considers correlations in the error terms of equation (3.1) for lnQ and lnS. The results are quite mixed (cf. table b.8 in the appendix): for the public expenditure choice I don't find evidence for the predicted positive impact of the TFP ($lnA1$), but the negative influence of the age structure ($lnAdr$) is again very strong. For lnS the findings are exactly the opposite: the coefficient for ω is surprisingly negative, but the effect of A is negative as the theory predicts.[26] Also in this analysis the default costs measure for b does not produce the signs that have been derived in chapter 2.
Moreover, the measure for public capital productivity provides the same weak evidence as in the above regressions.
Adding the set of controls, however, reduces the significancies dramatically, which is due to multicollinearity issues and not very surprising in this kind of analysis (cf. table b.9 in the appendix).

[25] Remember the large projects of Stuttgart's new underground main station "Stuttgart 21" or Brazil's huge public funding for the 2014 FIFA Football World cup and the 2016 Olympic Games.
[26] Note that in an OLS regression using only the observations of the SUR regression, the impact of ω turns positive again.

Thus, the assumption of correlations in the error terms does not really improve insights on the joint determination of government spending and debt. Therefore, I now turn to the analysis of the linking measure that was derived in theory, i.e. γ.

	(1) lnGamma b/se	(2) lnGamma b/se	(3) lnGamma b/se	(4) lnGamma b/se	(5) lnGamma b/se
lnA1	-0.281			0.806	4.315***
	(1.05)			(1.04)	(1.05)
lnMacap		-0.057		-0.124	0.189
		(0.09)		(0.13)	(0.14)
lnAdr			-2.345*	-2.964*	-3.190***
			(1.35)	(1.49)	(1.08)
lnGdpPc					-2.194***
					(0.71)
lnGvtExp					-0.065
					(0.59)
lnInst					0.212
					(0.52)
lnDebt					-0.093
					(0.19)
lnGvtBal					-0.013
					(0.06)
lnTaxRev					0.704
					(0.45)
lnInfl					-0.047
					(0.07)
lnSavingR					0.057
					(0.04)
lnDepr					0.740
					(1.09)
lnCaBal					-0.013
					(0.05)
lnTrade					-0.472
					(0.53)
_cons	1.287	-0.559***	-5.035*	-10.974	-5.906
	(6.32)	(0.11)	(2.67)	(7.35)	(5.78)
R^2	0.001	0.004	0.065	0.148	0.312
Observations	368	514	609	340	251
Countries	37	50	62	33	29

* p<0.1, ** p<0.05, *** p<0.01

Table 3.5: Gamma and TFP, FE

Since this variable is constructed as the ratio of q and s, the expected effects with respect to A, b, and ω are the same as for q (+,-,-).

Looking at table 3.5 the data confirm the positive influence of the TFP on γ empirically (at least in the full specification in column 5). In line with the above deliberations this indicates that the governments of more productive countries spend relatively more on investment rather than public consumption and issue relatively more of their debt domestically rather then at international financial markets[27].

As in the previous analysis the effect of $lnMacap$ on the combined measure γ is also rather poor. Where the model predicts a clearly negative impact of the possible default costs b, the data show this only in column 2 and 4, respectively, but when I add other control variables (column 5) the coefficient turns positive. Independent of the sign of β_2 there is no significance throughout all of the specifications using this variable.

Way better, though, is the empirical impact of ω. Both the regressions employing only the key country characteristics (columns 3 and 4) as well as the specification with a set of controls show the clear-cut negative effect that is theoretically derived above. The reason for this picture is that older cohorts do not care about repayment of foreign debt (and thus about its price or default costs, respectively) and therefore are in favor of accumulating a lot of it (resulting in a higher s) in order to prevail upon the government to spend these funds preferably on consumption rather than investment, whose fruits they would (probably) not be able to reap anymore (lower q).

Adding the set of control variables lifts the overall explanatory power to 31%, but surprisingly, the only measure that shows a significant coefficient is the economic size of a country ($lnGdpPc$). The negative sign indicates that more advanced countries exhibit a lower γ. Inferring from table 3.2 this effect is mainly driven by the negative impact of economic development for q, while the positive influence on s was not significant in table 3.4. The observation that the coefficients of the remaining controls appear to be not significantly different from 0 might be driven by the fact that at least seven out of these ten variables show the identical sign in their effect on q and s, respectively. For instance, the government's fiscal balance ($lnGvtBal$) would have a positive impact on relative public investment q as well as on the foreign debt quota s therewith possibly showing no effect on the ratio of both, i.e. γ.

[27] Recall that higher A generates more income and therewith allows for more domestic savings which enlarges the domestic debt market.

However, this outcome even persists if I use the lagged values of the explanatory variables (see table b.10 in the appendix), and also the results of column 1 through 4 in table 3.5 do not change if I restrict the sample size to the 251 observations of the full specification in column 5 (cf. table b.11).
The use of *lnCapprod_pub* as a determinant of γ does again not deliver further insights, but at least additionally confirms the negative influence of the age structure of the older generations (see table b.12 in the appendix).

Having empirically validated at least two of the three main characteristics that shape a government's decisions on where to issue debt and how to spend these funds, one question that might arise from this analysis is, whether these statements hold for rich as well as for poor countries either way. Therefore, I split the sample of the 29 countries that have been used in the full specification in table 3.5 along the income classification of the *Worldbank*[28].

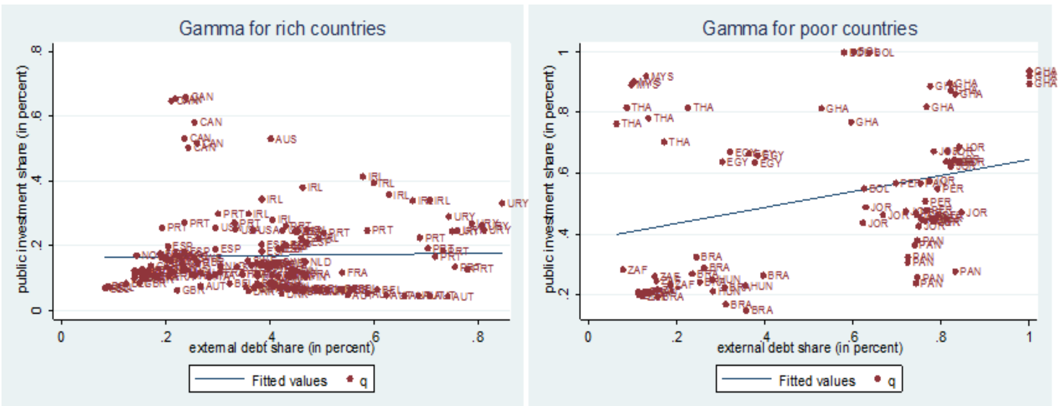

Figure 3.1: Correlation of q and s for rich and poor countries

Conjecturing that there might be differences across these two subgroups' governmental behavior, a first hint is given by the fact that γ is significantly smaller for the advanced economies (0.54) than for the poorer[29] ones (1.61)[30], which can also be seen in figure 3.1.

[28] This split assembles 18 high income economies on the one side (*AUS, AUT, BEL, CAN, DNK, FIN, FRA, DEU, IRL, ITA, NLD, NOR, PRT, ESP, SWE, GBR, USA, URU*) and 11 lower and upper middle income nations on the other (BOL, BRA, EGY, GHA, HUN, JOR, MYS, PAN, PER, ZAF, THA).

[29] Although the 11 countries of the second subgroup are not belonging to the low income nations, I will nonetheless call them the "poor" or "poorer" economies in order to distinguish them from the rich countries.

[30] Note that this mean is taken over all observations across time in the particular subgroup.

The interpretation of this is straightforward: given a certain foreign debt quota poorer countries exhibit a higher share of public investment in public expenditure or, alternatively, for a specific value of q the latter nations issue relatively less external debt.

	(1)	(2)	(3)	(4)	(5)
	lnGamma	lnGamma	lnGamma	lnGamma	lnGamma
	b/se	b/se	b/se	b/se	b/se
lnA1	-0.181			-1.489	6.736***
	(1.60)			(1.70)	(1.79)
lnMacap		-0.502***		0.007	0.049
		(0.15)		(0.17)	(0.15)
lnAdr			-8.672***	-9.069**	-6.713**
			(2.75)	(3.58)	(2.45)
lnGdpPc					-6.160***
					(1.18)
lnGvtExp					1.256
					(1.29)
lnInst					-2.102***
					(0.66)
lnDebt					-0.298
					(0.22)
lnGvtBal					0.088
					(0.05)
lnTaxRev					-0.868
					(0.55)
lnInfl					-0.079
					(0.08)
lnSavingR					0.821
					(0.70)
lnDepr					-4.133**
					(1.71)
lnCaBal					-0.023
					(0.05)
lnTrade					0.403
					(0.56)
_cons	0.213	-1.266***	-13.695***	-4.931	-11.759**
	(10.01)	(0.10)	(4.04)	(8.50)	(5.45)
R^2	0.000	0.151	0.402	0.420	0.697
Observations	166	166	166	166	166
Countries	18	18	18	18	18

* p<0.1, ** p<0.05, *** p<0.01

Table 3.6: Gamma and TFP for high income countries, FE

The focus of this analysis, however, is on the detection of exogenous country characteristics to explain the prevailing patterns of q and s. Therefore, I check whether the previous results for γ hold also for the two subgroups. The results can be seen in tables 3.6 and

	(1) lnGamma b/se	(2) lnGamma b/se	(3) lnGamma b/se	(4) lnGamma b/se	(5) lnGamma b/se
lnA1	1.594			2.046	4.177*
	(0.95)			(1.13)	(1.97)
lnMacap		0.092***		0.092	0.010
		(0.03)		(0.06)	(0.18)
lnAdr			0.673	-0.925	-2.785
			(0.89)	(1.06)	(1.76)
lnGdpPc					0.655
					(1.06)
lnGvtExp					0.279
					(0.36)
lnInst					0.650
					(0.57)
lnDebt					0.417*
					(0.20)
lnGvtBal					0.048
					(0.06)
lnTaxRev					-0.009
					(0.72)
lnInfl					-0.024
					(0.07)
lnSavingR					0.121**
					(0.05)
lnDepr					0.001
					(0.84)
lnCaBal					-0.002
					(0.03)
lnTrade					-0.187
					(0.60)
_cons	-9.025	0.153***	1.815	-13.916	-37.098*
	(5.43)	(0.02)	(2.30)	(8.53)	(17.20)
R^2	0.077	0.042	0.019	0.116	0.315
Observations	85	85	85	85	85
Countries	11	11	11	11	11

* p<0.1, ** p<0.05, *** p<0.01

Table 3.7: Gamma and TFP for non high income countries, FE

3.7. Most obviously, the positive effect of A as well as the negative impact of ω can be found for the high income nations in a very significant way. For the poorer countries the signs for these two characteristics are still the ones predicted by the theoretical model, but both lack significance.

A second insight of the sample split is that the TFP and the age structure of rich nations (together with the saving rate ($lnSavingR$) and the current account balance ($lnCaBal$)) can

explain the policymakers decisions on q and s to a large extent ($R^2 = 0.697$). For the less advanced countries the explanatory power is also substantially lower.
Summing up, as table 3.6 and 3.7 show, the theoretical model seems to be a better illustration of the rich nations' governments' behavior rather than the poorer ones.

3.5 Conclusion

The intention of this analysis was to test the theoretical results of chapter 2 empirically. Using a newly assembled dataset I found evidence that at least two of the three main characteristics, namely the economic productivity and the age structure of a country, indeed matter for the government's decision on where to borrow (domestically vs. externally) on the one hand and how to spend these funds (public investment vs. transfers) on the other hand. Whereas the total factor productivity has a positive impact on the future related public expenses, it reduces the relative importance of foreign liabilities in a government's debt profile. For the link of both decisions, i.e. the ratio of the public investment quota and the foreign debt quota, this implies a strong and significant positive effect.
The influence of a country's demographic structure is ambiguous too: Older societies spend relatively less on public investment but issue relatively more debt abroad at the same time. Thus, the demographic effect on the combined measure of the government's decisions is significantly negative.
For the possible maximum default costs a country would have to bear in case of non repayment, I found rather weak empirical support. However, the following chapter will draw on this outcome by endogenizing the default costs and derive the optimal policy when the government has some control over the income losses in case of non repayment of public debt.
Furthermore, I split the sample into rich and poor countries, which showed that the impact of productivity and age structure described above persist for the high income nations while for poorer countries the direction of the effects from the whole sample survives, but the significancies are almost lost. Therefore, the theoretical model seems to better illustrate the behavior of advanced and rich countries' policymakers.

Thus, further research based on the theoretical model should be interpreted as an attempt to describe the advanced countries' policy.

4 Foreign vs. domestic public debt and the composition of government expenditure: The commitment effect

4.1 Introduction

The model in chapter 2 is the first to explore the link between the policymakers choice of where to issue debt and how to spend these funds on a theoretical basis. It identifies three country characteristics that drive both of these policy choices. One of these characteristics are the potential default costs of a country. However, this variable enters the theoretical model as an exogenous parameter and therewith the model does not account for the fact that a government can influence the perception of its creditworthiness by foreign investors to a certain degree.

The most obvious way of this effect is surely via public debt management. Numerous studies have detected significant effects of the (external) debt stock or the government balance on the sovereign rating, i.e. on the creditworthiness of a country, e.g. among the first Cantor and Packer (1996) or most recently for a set of emerging markets Erdem and Varli (2014). Most of these authors thereby find a negative impact of high indebtedness or high deficits, respectively, on the price of future debt.

But beyond that direct link, there is also an effect of the policymaker's expenditure behavior on the perceived solvency of a government. Namely, the more forward looking a policymaker is using its funds, the more likely he will be able to generate future revenues

– think of infrastructure investments that pay off by higher tax earnings – and therewith the likelihood of a default is lower for a certain amount of debt due. In this sense, the public expenditure profile serves as a signal[1] for foreign investors, whether the country will be able or willing to repay debt in future or not.

This effect is touched by two strands of literature: first, it links to several studies on a government's reputation as a reason for the existence of foreign debt (e.g. Tomz (2012) or Borensztein and Panizza (2009))[2]. These papers show empirically that countries repay their debt, because they fear their reputation on international financial markets to worsen dramatically in case of a default, thus making newly issued foreign debt more costly. The effect of public investment expenditure as a signal for the future ability or willingness to repay debt obligations works in the same way – the less a policymaker spends on public investment the more expensive will be external funds. However, this reputational channel is valid only for one period in the model of this work, since future policy choices turned out to be independent of the current (default) decisions. In this sense, this study is closer to Afonso et al. (2011) who find positive effects of a government's effectiveness – i.e. a low level of bureaucracy, low corruption, etc. – for the creditworthiness (especially in the long run). There, the foreign investor similarly draws his inferences from observing the government's actions about the latter's future ability to reimburse.

The second strand of literature that relates to the effects a government's actions on its creditworthiness is the one on time consistency problems. As far as a policymaker has to decide on how to spend funds that have already been raised, it may be optimal to deviate from what he announced before the acquisition of the debt (cf. early works by Persson et al. (1987) and Bohn (1990) or more recently Debortoli and Nunes (2013)). Of course, this would be anticipated by the foreign investors beforehand, but as long as there is still an asymmetry of information between the two parties, there will be less optimal outcomes than without information asymmetries. Since in the current model the objective functions as well as the constraints are common knowledge to all actors, and so is the government's default decision, the policymaker can credibly kind of commit to a present investment share in total public expenditure. This induces the foreign lender to consider the pre-

[1] Just think of how many politicians are in media when they cut the ribbons opening new plants, motorways, etc. They want themselves to be perceived as growth and wealth enhancing policymakers.

[2] Often also Eaton and Gersovitz (1981) are cited in the context of reputation costs, but their analysis is rather about the threat of a permanent exclusion from international capital markets.

dicted policy in the pricing of its funds. Thus, the simple structure of the model makes it immune from time consistency problems such that the government's commitment about public expenditure is truly a credible one. Hence, in equilibrium the model in this chapter shows an additional *commitment effect* for some of the choice variables.
Due to this *commitment effect* there are three major changes compared to the outcomes of the basic model in chapter 2: At first, the issuance of external debt is now positively influenced by the productivity of a country. In the basic model there had not been such a link. Furthermore, the public investment quota is now negatively depending on the TFP, which comes from the positive impact of investment on foreign debt, that translates in a further increase of public transfers. And most notably, the age structure of a nation is now the central characteristic that can explain the link between the government's expenditure profile and its debt structure. Theoretically, I find that older societies have a lower ratio of the public investment quota to the foreign debt quota. This result, and that is the novelty compared to the basic model, is not influenced by the productivity of the country. Thus, the age distribution is the driving factor of this ratio.

While the link between government spending and public finance as a simultaneous decision on both is new in the literature (see section 2.2 for related articles), effects of demographic variables on the economic performance of a country are widely studied. Most of the investigations find evidence for output losses in older societies due to changes in the public expenditure pattern.[3] Following the early survey by Auerbach and Lee (2001) a lot of papers focus on education expenditure to model output declines in aging populations. Holtz-Eakin et al. (2004) find that less public spending on education would also lower the tax rate, but the overall growth effect would be negative, though. In contrast, Gradstein and Kaganovich (2004) agree with the latter statement, but they doubt that aging has a purely negative impact on education finance. Instead, they show theoretically and empirically that an increasing life expectancy results in higher education spending, because the younger need higher qualifications and therewith higher income to build up precautionary savings for a longer period of retirement. Closer to this approach is Kuehnel (2011) who

[3] Considerable exceptions are for instance Gonzalez-Eiras and Niepelt (2012), who additionally account for changes in the labor supply and the savings rate, and Kunze (2014), who can explain lower growth by the existence of bequests in an OLG setting.

also analyzes the distinction between a government's productive (in this model: public investment) and unproductive (public transfers) expenditure. In line with the results of this work she finds that older societies are characterized by higher unproductive public spending at the cost of investment-related expenditure. However, her paper is lacking the financing of public expenses, that delivers additional insights in this study. Furthermore, the focus of this work is not on intertemporal effects, but to identify country characteristics in order to explain political decisions about where to issue debt and how to spend the acquired funds.

The remainder of this chapter is structured as follows: section 2 presents the introduction of endogenous default costs in the theoretical model and derives the new equilibrium values for the choice variables. Section 3 then provides empirical evidence on the major changes that come along with the *commitment effect*. Section 4 concludes.

4.2 The extended model

In the basic model (see chapter 2) the maximum default costs a government[4] may experience are exogenously given by some amount $2b$, that is assumed to be smaller than the economy's total income of $2Y$. This upper bound plays a crucial role in the determination of the probability of default (p) and therewith in the equilibrium value of the cost (R) and volume (D^F) of foreign debt.

However, it is fairly realistic to think of the economy's values themself to be at stake in case of a default.[5] As e.g. Sturzenegger and Zettelmeyer (2007) show in their survey of the sovereign defaults in the late 90s and early 2000s a default comes along with immediate decreases in a country's output (for instance Argentina's GDP declined by about 11% in 2002 and Ecuador lost about 7% of its output in 2000).[6] This is reflected by the income Y

[4] As also in this model the government is the main actor that is executing the key choices I will switch between the terms "government", "country", and "nation", where all of them are used in the sense of "government".

[5] Remember the recent seizure of Argentinian assets in the US after defaulting on external debt.

[6] Of course, economic growth in Argentina, Ecuador, and other defaulting countries speeded up again in the following years. Nevertheless, this analysis does not focus on dynamic effects of the default decision, since the model is a stationary one.

in the model. Therefore, I will assume throughout this chapter, that the maximum default costs are no longer exogenously given, but rather are an outcome of the policymaker's decisionmaking. Specifically, the parameter b will now be replaced by domestic income Y_t^c, so a default could strike the domestic economy with costs of $2Y_t^c$ at most.[7]
This step incorporates a novel implication for the government's decision on public expenditure and debt: since public investment also determines the equilibrium income of the economy (cf. in chapter 2: $Y = A(K^G)^\alpha$), the policymaker is now in control of one of the key parameters that determine the foreign creditors' decision how much to lend. Namely the default costs, that determine the probability of non-repayment, and thus to some extent the price of external debt can now be influenced by the domestic government. In other words, the policymaker's choice of public spending is a commitment how to use the borrowed funds, that is considered by foreign lenders' decision on their credit supply. Therefore, I call the additional impact that the introduction of exogenous default costs has on the equilibrium values of the choice variables the *commitment effect*.

Compared to the original model, the household side remains the same (cf. equations (2.1) through (2.5)) as well as the government's budget constraint (cf. equation (2.6)). Introducing endogenous default costs changes the decision on foreign debt, though:
Let ζ_{t+1}^c be the random costs that will accrue to one generation in period $t+1$ if the government opts for non-repayment. ζ_{t+1}^c shall again be drawn from uniform distribution. The support, however, is now changing to $[0; Y_{t+1}^c(K_{t+1}^{G,c})]$. One can easily see that the government is now able to enlarge the interval ζ_{t+1}^c is drawn from by raising public investment[8], thereby increasing the maximum costs of a default. As the total costs for the economy amount to (possibly) $2Y_{t+1}^c$, the unconditional mean of the reduction in domestic income due to a default is given by $E(2\zeta_{t+1}^c) = Y_{t+1}^c$.

However, changing the upper bound of the distribution does not change the criterion of when to declare a default. Hence, *Lemma 2.1* still holds with a default in period $t+1$ being chosen by the government if

[7] In this chapter, I will augment all the variables and parameters with a superscript 'c' in order to illustrate the differences to the basic model.
[8] Recall that $K_{t+1}^{G,c}$ and $D_{t+1}^{F,c}$ are already chosen in period t.

$$\zeta^c_{t+1} < \hat{\zeta}^c_{t+1}, \tag{4.1}$$

where $\hat{\zeta}^c_{t+1} = \frac{1}{2} R^c_{t+1} D^{F,c}_{t+1}$.

Using this result, I can calculate the new default probability p^c_{t+1} for period $t+1$ (cf. equation (2.11)):

$$p^c_{t+1} = \frac{R^c_{t+1} D^{F,c}_{t+1}}{2Y^c_{t+1}(K^{G,c}_{t+1})} \tag{4.2}$$

For the interest rate on public debt equation (2.12) changes to[9]:

$$R^c_{t+1} = \frac{1}{1 - p^c_{t+1}} = \frac{1}{1 - \frac{R^c_{t+1} D^{F,c}_{t+1}}{2Y^c_{t+1}(K^{G,c}_{t+1})}} \tag{4.3}$$

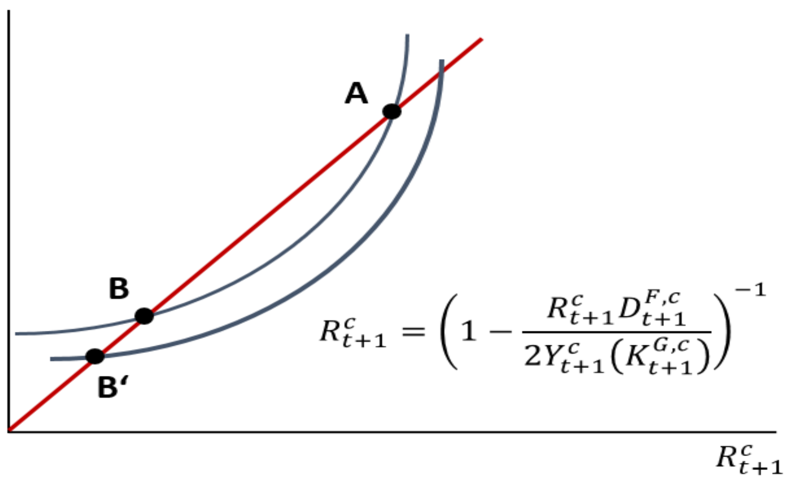

Figure 4.1: The interest rate on government debt with commitment effect

The determination of the equilibrium interest rate is equivalent to the basic model: I assume that the possible equilibrium in point **A** in figure 4.1 is not stable, since it incorporates a high interest rate and a high probability of default and there is always

[9] The solution for (4.3) is now: $R^c_{t+1} = \frac{Y^c_{t+1} - \sqrt{(Y^c_{t+1})^2 - 2D^{F,c}_{t+1} Y^c_{t+1}}}{D^{F,c}_{t+1}}$.

an incentive for any single lender to offer credit at the conditions in point **B** instead (lower interest rate and probability of default, respectively), which will be preferred by the domestic government. Hence, point **B** is also the relevant equilibrium in the case with endogenous default costs.

Additionally, figure 4.1 highlights the *commitment effect* the model now comprises: by choosing public investment (K^G_{t+1}) the government also influences the probability of default (cf. (4.2)) for debt that becomes due in the following period and therewith the price of its debt. Thus, the lower curve in figure 4.1 represents the right-hand side of (4.3) in case of increased public investment. Evidently, this more future-related policy is honored by the external creditors and results in a lower equilibrium interest rate (point **B'**).

One should, however, notice that there is a second effect that determines the shift of the curve in figure 4.1: the change in the parameters of the external credit supply, i.e. in p^c_{t+1} and R^c_{t+1}, will induce the foreign investor to adjust his volume of credit $D^{F,c}_{t+1}$. At a lower default probability and interest rate more foreign debt will be disposable for the domestic government. This effect shifts the lower curve in figure 4.1 back towards the initial curve or even further. In equilibrium, which I will show later, both effects will neutralize. Thus, with higher public investment, we will end up again in point **B**, i.e. there is no change in p^c_{t+1} and R^c_{t+1}, but the volume of external debt $D^{F,c}_{t+1}$ will be higher.

If we consider all these novel interdependencies, the government's objective function now looks slightly different than in the basic model (cf. equation (2.13))

$$\begin{aligned} V^{G,c}_t = \omega & \left[2Y^c_t(K^{G,c}_t) + D^{F,c}_{t+1} - K^{G,c}_{t+1} - \varphi_t R^c_t D^{F,c}_t - 2(1-\varphi_t)\zeta^c_t\right] \\ &+ (1-\omega)\Bigg[2Y^c_{t+1}(K^{G,c}_{t+1}) + D^{F,c}_{t+2} - K^{G,c}_{t+2} - D^{F,c}_{t+1} \\ &- 2\int_0^{\hat{\zeta}^c_{t+1}} \zeta^c_{t+1} dF(\zeta^c_{t+1})\Bigg] \end{aligned} \tag{4.4}$$

The difference one should keep in mind here, is the fact that $\hat{\zeta}^c_{t+1}$ is now also depending on public investment.[10] Employing the same production function as in chapter 2,

[10] Using (4.1) and (4.3) we obtain: $\hat{\zeta}^c_{t+1} = \frac{Y^c_{t+1} - \sqrt{(Y^c_{t+1})^2 - 2D^{F,c}_{t+1}Y^c_{t+1}}}{2}$.

$Y^c_{t+1}(K^{G,c}_{t+1}) = A(K^{G,c}_{t+1})^\alpha$, leads to the following optimal choices of public investment, income, and foreign debt:

$$\tilde{K}^{G,c}_{t+1} = \tilde{K}^{G,c} = \left(\frac{\alpha A}{j}\right)^{\frac{1}{1-\alpha}} \tag{4.5}$$

$$\tilde{Y}^c_{t+1} = \tilde{Y}^c = A(\tilde{K}^{G,c})^\alpha = A^{\frac{1}{1-\alpha}}\left(\frac{\alpha}{j}\right)^{\frac{\alpha}{1-\alpha}} \tag{4.6}$$

$$\tilde{D}^{F,c}_{t+1} = \tilde{D}^{F,c} = \frac{x}{2}\tilde{Y}^c = \frac{1}{2}(1-\frac{1}{z^2})A^{\frac{1}{1-\alpha}}\left(\frac{\alpha}{j}\right)^{\frac{\alpha}{1-\alpha}} \tag{4.7}$$

Again, I substituted some expressions to get a more clear picture from these equations: Specifically, $z \equiv \frac{2\omega}{(1-\omega)} - 1$ is the same as in the original model.[11] Additionally, the substitutes x and j are also rising in z and thus ω.[12]

Still, the model parameters are constant and hence the equilibrium values of the choice variables are constant over time as well.

From (4.5) one can infer that the properties of $\tilde{K}^{G,c}$ are the same as in the basic model: first, the more productive (A) this type of expenditure is, the more attractive it is for the government to use its funds therefor. Second, the more powerful the old generation is in the political process (ω), the lower will be public investment in equilibrium. The same holds true also for the economy's total income in (4.6).

The novelty due to the *commitment effect* is, that now also the decision of how much external debt a government should issue (4.7) is depending on the country's productivity: the more effective public investment is turned into next period's output/income (i.e. a large A), the higher will be $\tilde{D}^{F,c}$.[13]

[11] Note that z is rising in ω, i.e. $\frac{\partial z}{\partial \omega} > 0$, and by assuming $\omega \geq 0.5$ follows: $z \geq 1$.
[12] Specifically, the terms read: $x = (1 - \frac{1}{z^2}) > 0$ and $j = \frac{z+1}{2.5+0.5z+1.5z^{-1}-0.5z^{-2}} > 0.5$.
[13] See below for a detailed description of this effect.

The impact of ω is rather ambiguous – two effects are influencing the optimal choice of foreign debt in opposite directions:[14] On the one hand, a larger share of older people (i.e. a large ω) leads to higher external borrowing, simply because they do not care about repayment in the following period. Their only desire is to get as much transfers as possible and use them for consumption. This is the traditional effect that we also had in the basic model. Let me call it *consumption effect* from now on.
On the other hand, there is the *commitment effect* which is reducing external debt. This comes due to the fact that a larger share of older people uses its political power to shift public expenditure from investment towards transfers. This has the important implications for the external credit supply I mentioned above: As less investment-related expenses lower next period's income and thus the "collateral" in case of a default, we learned from (4.2) and (4.3) that this c.p. results in a higher default probability and a higher interest rate on foreign debt. However, since $\tilde{D}^{F,c}$ is more expensive now, the policymaker will reduce the amount he is borrowing abroad. This, in turn, lowers p^c_{t+1} and R^c_{t+1} again.

In equilibrium, however, these two effects cancel each other so that the values of the default probability $\tilde{p}^c$ and the interest rate $\tilde{R}^c$ are not depending on either the *consumption* or the *commitment effect*. Naturally, their equilibrium values are the same as in (2.20) and (2.19):

$$\tilde{p}^c = \frac{z-1}{2z} \tag{4.8}$$

$$\tilde{R}^c = \frac{2z}{z+1} \tag{4.9}$$

This result seems rather counterintuitive. But recall what the government is able to steer by deciding on its expenditure profile: using more of its funds for investment-related purposes, the policymaker enhances next period's income $\tilde{Y}^c$ and therewith the maximum of the possible default costs. Figure 4.2 depicts the interval from which the random default

[14] See appendices C.1 and C.2 for the mathematical expressions.

costs ζ^c are drawn with the length of the bar being influenced by the government's choice of $\tilde{K}^{G,c}$.

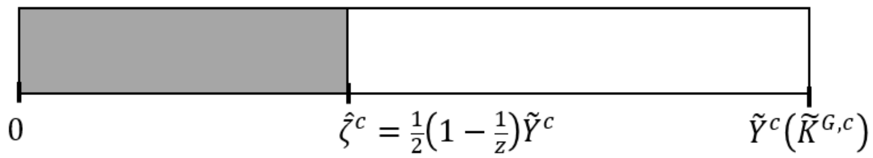

Figure 4.2: Default costs ζ^c with support $[0; \tilde{Y}^c]$

The crucial point is, that in equilibrium the threshold value of the default decision is a constant fraction of the economy's income, namely

$$\hat{\zeta}^c = \tfrac{1}{2}(1 - \tfrac{1}{z})\tilde{Y}^c. \tag{4.10}$$

This states that the equilibrium probability of default $\tilde{p}^c$ – represented by the shaded area in figure 4.2 – will not change due to shifts in the government's expenditure behavior, because, as described above, the *consumption* and the *commitment effect* cancel each other. Hence, the only impact of the latter effect on the equilibrium values is that the foreign lenders honor the creation of more collateral due to enhanced public investment by lending a higher volume of external funds, i.e. $\frac{\partial \tilde{D}^{F,c}}{\partial \tilde{Y}^c} > 0$.

The determination of the default dependent domestic debt and transfers in equilibrium is than straightforward and leads to the same results as in equations (2.21) through (2.24):

$$\begin{aligned} \tilde{D}^{H,c}_{t+1}(\varphi_t = 0) &= 2\tilde{Y}^c + \tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\zeta^c_t \\ &= \Lambda^c - 2\zeta^c_t, \end{aligned} \tag{4.11}$$

with $\Lambda^c = 2\tilde{Y}^c + \tilde{D}^{F,c} - \tilde{K}^{G,c} > 0$.

$$\begin{aligned}\tilde{D}^{H,c}_{t+1}(\varphi_t = 1) &= 2\tilde{Y}^c + \tilde{D}^{F,c} - \tilde{K}^{G,c} - \tilde{R}^c(\tilde{D}^{F,c} + D^{H,c}_t) \\ &= \Lambda^c - 2\hat{\zeta}^c - \tilde{R}^c D^{H,c}_t\end{aligned} \tag{4.12}$$

$$\begin{aligned}\tilde{T}^c_t(\varphi_t = 0) &= \tilde{Y}^c + \tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\zeta^c_t \\ &= \Pi^c - 2\zeta^c_t\end{aligned} \tag{4.13}$$

$$\begin{aligned}\tilde{T}^c_t(\varphi_t = 1) &= \tilde{Y}^c + \tilde{D}^{F,c} - \tilde{K}^{G,c} - \tilde{R}^c(\tilde{D}^{F,c} + D^{H,c}_t) \\ &= \Pi^c - 2\hat{\zeta}^c - \tilde{R}^c D^{H,c}_t,\end{aligned} \tag{4.14}$$

with $\Pi^c = \Lambda^c - \tilde{Y}^c$.

As in the basic model one can infer from these equations that the level of domestic debt as well as the volume of transfers are higher if the government decides for non-repayment, i.e. $\tilde{D}^{H,c}_{t+1}(\varphi_t = 0) > \tilde{D}^{H,c}_{t+1}(\varphi_t = 1)$ and $\tilde{T}^c_t(\varphi_t = 0) > \tilde{T}^c_t(\varphi_t = 1)$.

Having derived all the equilibrium values we can now turn to the 'quotas' we are mainly interested in:
For the external to total debt ratio in case of default and repayment, respectively, the equilibrium values are given by[15]

$$\tilde{s}^c_t(\varphi_t = 0) = \frac{\tilde{D}^{F,c}}{\tilde{D}^{F,c} + \tilde{D}^{H,c}_{t+1}(\varphi_t = 0)} := \frac{\tilde{D}^{F,c}}{\Omega^c_t(\varphi_t = 0)} \tag{4.15}$$

and

$$\tilde{s}^c_t(\varphi_t = 1) = \frac{\tilde{D}^{F,c}}{\tilde{D}^{F,c} + \tilde{D}^{H,c}_{t+1}(\varphi_t = 1)} := \frac{\tilde{D}^{F,c}}{\Omega^c_t(\varphi_t = 1)}. \tag{4.16}$$

[15] Here, I once again stick to the notation of the basic model, so that $\Omega^c_t(\varphi_t = 0) = \tilde{D}^{F,c} + \Lambda^c - 2\zeta_t$ and $\Omega^c_t(\varphi_t = 1) = \tilde{D}^{F,c} + \Lambda^c - 2\hat{\zeta}^c - \tilde{R}D^{H,c}_t$.

The calculation of the optimal share of public investment in total public expenditure leads to

$$\tilde{q}_t^c(\varphi_t = 0) = \frac{\tilde{K}^{G,c}}{\tilde{K}^{G,c} + 2\tilde{T}_t^c(\varphi_t = 0)} := \frac{\tilde{K}^{G,c}}{\Omega_t^c(\varphi_t = 0)} \tag{4.17}$$

and

$$\tilde{q}_t^c(\varphi_t = 1) = \frac{\tilde{K}^{G,c}}{\tilde{K}^{G,c} + 2\tilde{T}_t^c(\varphi_t = 1) + \tilde{R}^c(\tilde{D}^{F,c} + D_t^{H,c})} := \frac{\tilde{K}^{G,c}}{\Omega_t^c(\varphi_t = 1)}, \tag{4.18}$$

with $\Omega_t^c(\varphi_t = 0)$ and $\Omega_t^c(\varphi_t = 1)$ being defined above.

From (4.15) and (4.16) we can conclude that $\Omega_t^c(\varphi_t = 0) > \Omega_t^c(\varphi_t = 1)$ and consequently that both quotas are lower if the government opts for default.

Finally, we can derive the key variable in the model, the ratio of both quotas γ^c:

$$\gamma^c = \frac{\tilde{q}_t^c}{\tilde{s}_t^c} = \frac{\tilde{K}^G}{\tilde{D}^F} = 2\alpha(xj)^{-1} \tag{4.19}$$

The interpretation of (4.19) is straightforward: γ^c links the government's expenditure behavior $\tilde{q}^c$ to its debt pattern $\tilde{s}^c$. By construction, this relationship is a positive one. Moreover, it is stationary in equilibrium and independent of the default decision.
Additionally, (4.19) highlights two important changes regarding the basic model: First, γ^c is no longer influenced by the productivity parameter A. This comes from the fact that due to the *commitment effect* also the optimal choice of foreign debt $\tilde{D}^F$ is depending on A now. By calculating the ratio of public investment $\tilde{K}^G$ and the latter, however, the productivity parameter cancels out.[16]

[16] Note that despite A is out of responsibility for the determination of γ^c, the parameter α, which also captures the productivity of public investment to some extent, still executes a positive influence on the relationship of the ratios.

Second, the main determinant of γ^c is now the political power of the older generation ω.[17] Building the derivative of (4.19) with respect to ω shows that γ^c is decreasing the more powerful the older ones are in the political process. This effect itself is in line with the original model, although this framework incorporates the additional *commitment effect*. But in equilibrium the latter one is not strong enough to overcompensate the traditional *consumption effect* on foreign debt $\tilde{D}^{F,c}$ (see appendix C.2 for a proof), leaving the overall impact of ω on γ^c negative. The novelty in comparison with the original model is that ω is now the only determinant of the factor of proportionality between $\tilde{q}^c$ and $\tilde{s}^c$. This will help to explain patterns that we obtain from the data in the next section.

4.3 Empirical evidence

In this section I will bring the theoretical results from the model presented above to the data. To this end, I employ the dataset used in chapter 3.

The implementation of the *commitment effect* changed some of the equilibrium values of the choice variables considerably. We learned from (4.15) through (4.19) that the quotas q^c and s^c are subject to changes that stem from the newly detected dependency of $\tilde{D}^{F,c}$ on the TFP (cf. equation (4.7)).
As a result, also γ^c shows some new features compared to γ of the basic model. First and foremost, the most obvious change is that the equilibrium value of γ^c is no longer depending on the productivity A and the possible default costs b of a country. Whereas the latter variable vanishes due to endogenization, A now exercises the same effect – in terms of direction and size – on both the investment quota q^c and the foreign debt quota s^c, therewith having no impact on the ratio γ^c. Consequently, a nation's age structure ω remains the only country characteristic that determines the relationship of q^c and s^c (cf. equation (4.19)).

A first look at the data seems to support this result: the two scatterplots in figure 4.3 depict the relationship between the expenditure profile (q) and the composition of gov-

[17] Remember that x and j are both depending on z, which is determined by ω.

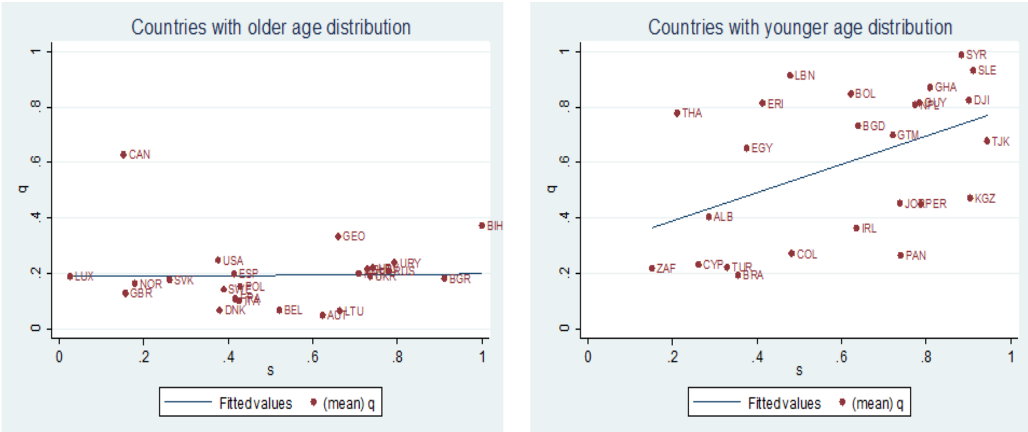

Figure 4.3: The composition of public spending (q) and the structure of government debt (s) for old and young countries. 3 year averages for the 2002 to 2004 period. Data source: Panizza (2008), OECD and World Bank (WDI)

ernment debt (s) for 59 countries in total.[18] Cutting the sample in half along the age structure, i.e. by the median of the age dependency ratio of the old, assembles mainly the advanced nations in the world stocked up with some of the Eastern Europe developing countries (plus Uruguay) in the left hand picture. While these nations' share of above-working-age people is relatively large, they exhibit a very low correlation (0.0179) between their public spending behavior and debt structure at the same time.[19] On the other hand, the rather young countries at the right – mainly consisting of developing countries from Africa, Latin America, and Asia – show a much higher correlation (0.4758).[20]

This observation is exactly what we should expect from the results of the theoretical model above: the relationship between a government's spending profile (q) and the way to fund these expenses (s) is more positive (in mathematical terms) in economies with a relatively young age distribution, i.e. $\frac{\partial \tilde{\gamma}^c}{\partial \omega} < 0$. The reason for this is that governments of older populations act rather in favor of these people in the form of higher current transfers

[18] I computed 3 year averages of q_t and s_t in order to smoothen the effects of one-time measures on either the policymakers' way to issue foreign and domestic bonds or the governments' expenditure behavior – e.g. the German *Umweltprämie*, often called *Abwrackprämie*, that worked like consumption vouchers and raised the public transfers in 2013 by exceptional 5 bn Euro.

[19] Obviously, this low correlation is partly driven by the observation for Canada, that exhibits extremely low social security expenses (which corresponds to transfers in the model). But even omitting this datapoint would deliver a lower correlation (0.3985) for the older countries.

[20] This much higher correlation for younger countries is not limited to the 2002 to 2004 period. Specifically, the picture looks quite similar for other 3 year periods between 1993 and 2007. Also the use of 5 year averages does not change this result significantly. Furthermore, if I divide the countries into "young" and "old" ones by the mean of ω, this would also not alter the impression we already got from figure 4.3.

instead of forward-looking investment expenditure. Additionally, the older generations do not care about the repayment of public debt in future, and therefore they want the government to issue as much foreign debt as possible in order to finance as much transfers as possible. These effects drive down the equilibrium value $\tilde{q}^c$ and increase $\tilde{s}^c$, respectively. As a result γ^c is lower for higher ω.

However, the negative impact of the age distribution on γ also was an outcome of the basic model. The novelty in implementing the *commitment effect* is, that the parameter A no longer plays a role for the determination of γ^c. In chapter 2 γ was positively depending on the TFP, while there is no such (theoretical) dependency for γ^c. Consequently, one would expect to find rather the same correlation of q and s for productive and less productive countries.

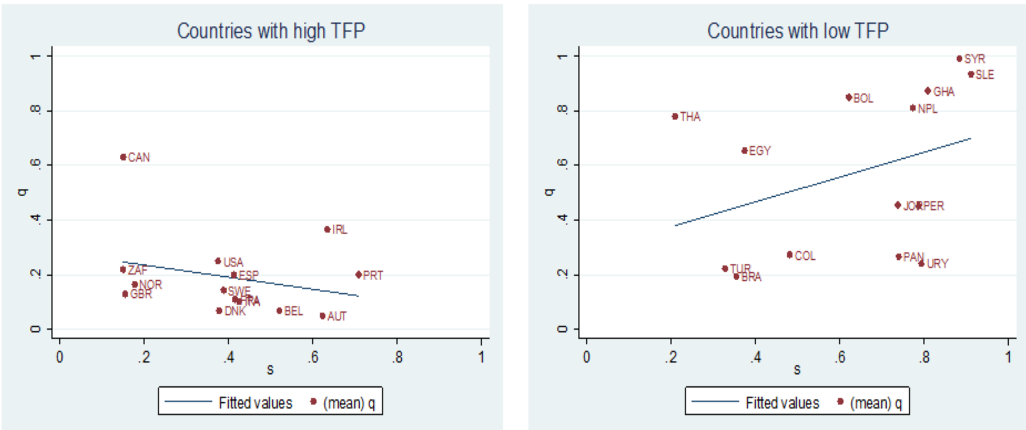

Figure 4.4: The composition of public spending (q) and the structure of government debt (s) for countries with high and low TFP. 3 year averages for the 2002 to 2004 period. Data source: Panizza (2008), OECD and World Bank (WDI)

Looking at figure 4.4 reveals a different picture, though: if I split the sample along the TFP – the median of the TFP measure from Daude and Fernandez-Arias (2010) is the cut-off point – I find that countries with higher A show a lower (and even negative) γ than nations with lower TFP.[21] This is not in line what the *commitment effect* model suggests, but also contradicts the theoretical results from the basic model. However, a comparative

[21] The correlation of q and s for the productive half of the sample is -0.2725, while the less productive countries exhibit a correlation of 0.3530. This pattern is quite stable across all the 3-year periods. If we exclude again Canada from the sample, the correlation for the productive countries is small but at least positive (0.0769).

look at figures 4.3 and 4.4 shows that the left hand parts of both pictures gather roughly the same countries (old and productive), and so do the scatterplots to the right (young and less productive), respectively, thus indicating a strong correlation between A and ω. And indeed, in the sample both characteristics are linked by a correlation of 0.79. Therewith, it seems to be very unlikely to detect both, a negative impact of ω and no (or even a positive) effect of A on γ^c at the same time with this simple descriptive approach.

But as mentioned in chapter 3 the theoretical structure of the model allows to read the parameter A not only as the country's TFP. Alternatively, it can be interpreted as the productivity of a nation's (public) capital stock K^G. Since there is no comprehensive database on public capital stocks – neither the timeframe of this study nor the amount and diversity of countries I look at is covered[22] –, I use the same approximative measure as in chapter 3: since the measure for the capital stock from the Penn World Tables 8.1 is calculated using the perpetual inventory method, which incorporates the use of periodical investment, I assume that the *public share in total investment* is similar to a country's *public share in the total capital stock*. By dividing the nation's GDP by the public capital stock, I get a measure for the productivity of public capital (*capprod_pub*).

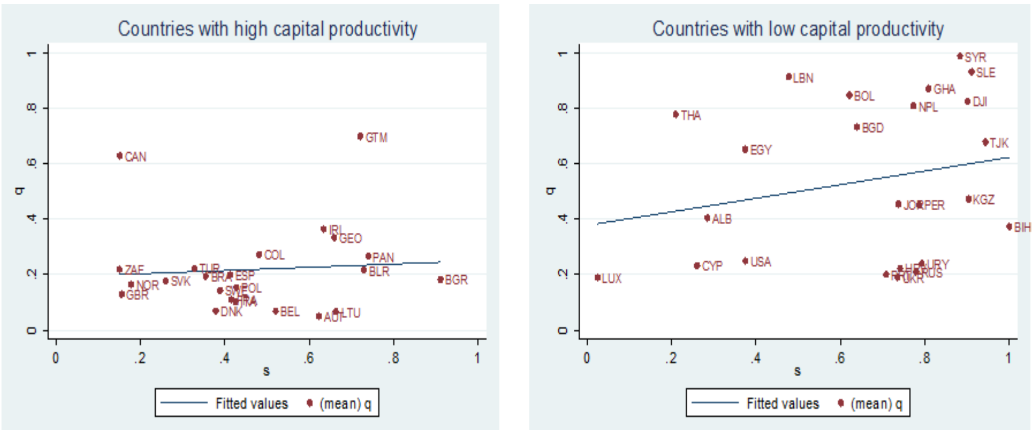

Figure 4.5: The composition of public spending (q) and the structure of government debt (s) for countries with high and low public capital productivity. 3 year averages for the 2002 to 2004 period. Data source: Panizza (2008), OECD and World Bank (WDI)

[22] E.g. Kamps (2006) provides a small database with estimates of capital stocks for 22 OECD countries up to 2001.

Figure 4.5 shows the median-split sample along the productivity of public capital. Again, there is an obvious difference in the correlation of q and s for productive (0.0765) and less productive countries (0.2294).[23] At least both of the measures are positive, but in principal this interpretation of A offers the same results as the TFP in figure 4.4.

However, even if these graphs would support the theoretical results, this would not be a proof of causality. In order to tackle this issue, I will now test whether the changes that the introduction of the *commitment effect* brings about can be found in a regressional analysis.

Therefore, I first investigate the impact of A on the equilibrium value of foreign debt: from (4.7) one can see that, with the *commitment effect* being in play, $\tilde{D}^{F,c}$ is now positively depending on the (capital) productivity of a country. This effect did not exist in the basic model.

Table 4.1 tries to trace this effect by showing the results of a FE-estimation of the log-linearized form of (4.7):[24]

$$\ln \tilde{D}^{F,c}_{i,t} = \beta_0 + \beta_1 \ln A_{i,t} + \beta_2 \ln \omega_{i,t} + \beta_3 \ln X_{i,t} + \epsilon_{i,t} \tag{4.20}$$

The results, however, are rather disappointing: regressing the external debt to GDP ratio on either the TFP (column 1-3) or the productivity of public capital measure (column 4-6) does not yield the positive coefficients that the *commitment effect* theoretically induces (column 1 and 4). Moreover, the introduction of the age dependency ratio of the old ($lnAdr$) – capturing ω – does not alter the coefficient (column 2 and 5). Finally, adding a set of control variables (column 3 and 6) reduces the significance of $lnA1$ without changing its negative sign, while the productivity of public capital is at least positive but still insignificant. However, although being not significant, at least ω has the expected positive effect on external debt in three of four specifications, i.e. older societies induce their policymakers to accumulate higher stocks of foreign debt.

[23] Leaving out the observation of Canada would in this case lift the correlation of the productive nations above the one of the less productive ones (0.3170).

[24] See equation (3.1) for the explanation of the summands.

	(1) lnFD b/se	(2) lnFD b/se	(3) lnFD b/se	(4) lnFD b/se	(5) lnFD b/se	(6) lnFD b/se
lnA1	-1.376***	-1.328***	-2.040**			
	(0.39)	(0.36)	(1.01)			
lnCapprod_pub				-0.014	-0.017	0.089
				(0.06)	(0.06)	(0.09)
lnAdr		-0.334	0.910		0.224	0.062
		(0.59)	(0.90)		(0.54)	(0.65)
lnGdpPc			-1.582**			-2.388***
			(0.59)			(0.27)
lnGvtExp			0.191			0.340*
			(0.28)			(0.18)
lnInst			-0.563**			-0.303
			(0.27)			(0.22)
lnDebt			0.389**			0.727***
			(0.15)			(0.11)
lnGvtBal			0.064			0.042
			(0.04)			(0.03)
lnTaxRevGdp			-0.596*			-0.355*
			(0.31)			(0.19)
lnInfl			0.103**			0.042
			(0.04)			(0.03)
lnSavingR			0.046			0.067**
			(0.03)			(0.03)
lnDepr			-0.446			-0.134
			(0.73)			(0.73)
lnCaBal			0.010			-0.001
			(0.03)			(0.02)
lnTrade			0.575**			0.427*
			(0.28)			(0.24)
_cons	6.458***	5.412**	18.437***	-1.425***	-0.914	12.058***
	(2.22)	(2.55)	(4.48)	(0.03)	(1.23)	(3.44)
R^2	0.058	0.060	0.303	0.000	0.001	0.382
Observations	1166	1166	456	1582	1582	623
Countries	74	74	51	115	115	71

* p<0.1, ** p<0.05, *** p<0.01

Table 4.1: Foreign debt, FE

The set of control variables adds 20-30% to the within R^2. The factors that contribute significantly to the explanation of the variation of external debt in both specifications (column 3 and 6) are the total debt stock, GDP per capita, tradeopenness, and the domestic tax revenue to GDP ratio. All of these effects follow economic intuitions: countries with a large stock of total debt tend to comprise also large stocks of external liabilities; the negative effect of output/income per capita may well be explained by the fact that very rich countries (per capita) do have large domestic debt markets that suffice for their government's debt needs; the positive impact of trade indicates a general openness towards foreigners due to trade and therewith also for external investors which drives up foreign debt; finally, having a lot of tax revenues suggests that there is less need for financing government expenses by issuing external debt.[25] These results for A and ω do not change, if I restrict the data for the simple regressions in column 1 and 2, and 4 and 5, respectively to the observations used in the regressions with the controls (column 3 and 6).

One may argue that the effect of a country's productivity on the decision about foreign debt might be such that past productivity will be assessed before the decision where to issue public debt. Therefore, I also check, whether the inclusion of the lagged values of A changes the above findings. As table c.1 in the appendix reports, besides less explanatory power and some controls turning insignificant, including the lagged effects does not alter the results in this specification.

However, another interpretation of the D^F variable in the model would be that this reflects just the government's part of the *deficit* that is owned by foreigners rather than the *stock* of external liabilities. Thus, I run the same FE regressions again substituting the growth rate of external debt as dependent variable. As one can infer from table c.2 in appendix C.4 the results in the coefficients of A and ω change only in the way that β_1 loses its significance with the TFP measure while it gains some significance for the public capital productivity. Moreover, the within R^2 is rather poor and the impact of ω is significantly negative.

[25] Forslund et al. (2011) investigate determinants of the domestic debt quota and find the same effects for GDP and total debt. For tradeopenness they detect a negative impact on the domestic debt share at least in a sub-sample using a random effects model.

	(1)	(2)	(3)	(4)	(5)	(6)
	lnQ	lnQ	lnQ	lnQ	lnQ	lnQ
	b/se	b/se	b/se	b/se	b/se	b/se
lnA1	-0.031	0.429*	1.073**			
	(0.41)	(0.23)	(0.39)			
lnCapprod_pub				-0.279***	-0.261***	-0.447***
				(0.08)	(0.08)	(0.09)
lnAdr		-1.532***	-1.136***		-0.655**	-0.978**
		(0.25)	(0.26)		(0.28)	(0.43)
lnGdpPc			-0.341*			0.538***
			(0.18)			(0.16)
lnGvtExp			0.207			-0.079
			(0.13)			(0.14)
lnInst			0.077			-0.110
			(0.17)			(0.12)
lnDebt			-0.057			-0.226***
			(0.06)			(0.05)
lnGvtBal			0.042*			0.050**
			(0.02)			(0.02)
lnTaxRevGdp			-0.111			0.202
			(0.11)			(0.12)
lnInfl			0.013			0.028**
			(0.01)			(0.01)
lnSavingR			0.079***			0.155***
			(0.02)			(0.03)
lnDepr			0.182			-0.050
			(0.27)			(0.46)
lnCaBal			-0.037*			-0.033**
			(0.02)			(0.02)
lnTrade			0.052			-0.024
			(0.12)			(0.13)
_cons	-1.114	-6.873***	-7.286***	-1.089***	-2.417***	-7.054***
	(2.44)	(1.55)	(2.59)	(0.05)	(0.55)	(2.06)
R^2	0.000	0.271	0.327	0.201	0.240	0.534
Observations	541	541	312	1019	1008	451
Countries	44	44	32	77	76	49

* p<0.1, ** p<0.05, *** p<0.01

Table 4.2: Investment quota, FE

The robustness check with the lagged values of the TFP and capital productivity measures leads to even less significancies (see table c.3 in the appendix).
All in all, the theoretically positive effect of productivity on foreign debt can hardly be found in the data.

Next, I turn to the investigation of the second change induced by the introduction of the *commitment effect*. One can demonstrate that the impact of A on the public investment quota q in equilibrium ((4.17) and (4.18)) is now negative (see appendix C.3.1 for a mathematical proof). Compared to the basic model the *commitment effect* is turning this dependency upside down. This comes from the fact that the positive influence of productivity on external debt raises the government's scope for expenditure. In equilibrium the relative increase of transfer expenses is thereby larger than the relative surge in investment, causing q to be smaller for more productive countries.

Table 4.2 is similar to table 3.2 in chapter 3, where especially the empirical results for the effect of public capital productivity (*capprod_pub*) on q could not be explained by the basic model. Starting with the first three columns one can see that a negative impact of the TFP on a government's share of investment in total expenditure cannot be recognized once we include the age dependency ratio of the old and even less if we stack up the regression with a set of controls. In fact, the coefficient for $lnA1$ becomes more and more positive and significant.

However, employing the measure for public capital productivity (column 4 through 6), we detect a significantly negative effect on q that is even stronger if we include ω and the control variables in the regression. Combined with the negative sign at high significance levels for the age dependency ratio of the old these results perfectly match the prediction from the *commitment effect* augmented model.

The significant impact of some controls on the public investment quota are the same as in table 3.2.

Finally, the main variable of interest in the above model is the relationship of q and s, i.e. γ^c. As pointed out earlier the key difference that is caused by the *commitment effect* is the independence of the latter variable from a country's productivity A. Similar to the descriptive investigations above that did not give a clear picture about this link, also the regressions to detect a causal (non)impact are not unambiguous: table 4.3 shows that the public capital productivity measure (column 4 through 6) has a stable but negative effect on the relationship of q and s throughout all specifications. This result is neither in line with the basic model (where we expected a positive effect) nor with the extension in this chapter (where the model predicts no significant effect at all).

	(1)	(2)	(3)	(4)	(5)
	lnGamma	lnGamma	lnGamma	lnGamma	lnGamma
	b/se	b/se	b/se	b/se	b/se
lnA1		0.625	3.971***		
		(1.07)	(0.97)		
lnCapprod_pub				-0.370*	-0.697***
				(0.19)	(0.16)
lnAdr	-2.345*	-3.510**	-2.747***	-2.333	-2.454**
	(1.35)	(1.51)	(0.90)	(1.44)	(1.02)
lnGdpPc			-1.687***		0.539*
			(0.56)		(0.30)
lnGvtExp			-0.236		-0.771
			(0.55)		(0.51)
lnInst			0.443		-0.276
			(0.47)		(0.28)
lnDebt			-0.026		-0.406***
			(0.16)		(0.09)
lnGvtBal			-0.009		0.011
			(0.06)		(0.05)
lnTaxRevGdp			0.724*		0.900***
			(0.40)		(0.22)
lnInfl			-0.055		-0.025
			(0.05)		(0.03)
lnSavingR			0.055		0.219***
			(0.04)		(0.05)
lnDepr			1.245		0.947
			(0.96)		(1.06)
lnCaBal			-0.019		-0.018
			(0.05)		(0.04)
lnTrade			-0.202		-0.185
			(0.37)		(0.27)
_cons	-5.035*	-10.960	-7.198	-4.678*	-0.971
	(2.67)	(7.05)	(5.34)	(2.73)	(4.55)
R^2	0.065	0.133	0.279	0.122	0.340
Observations	609	368	262	575	392
Countries	62	37	30	58	47

* p<0.1, ** p<0.05, *** p<0.01

Table 4.3: Gamma, FE

However, for the TFP measure (column 1 through 3) the coefficients are positive and significant even at the 1% level for the full specification with control variables[26]. Still surprisingly, in this specification only the TFP, age structure, economic performance per capita, and slightly the size of tax revenues can explain almost 28% of the variance of γ. Altogether, I get opposing results for the two measures of productivity. However, looking at (4.19) reveals a potential explanation for the positive sign of the TFP variable: the equilibrium value of γ^c still contains the parameter α that captures the output elasticity of (public) capital in the model. In other words, α also incorporates some information about the productivity of a country's input factors. As long as $\frac{\partial \gamma^c}{\partial \alpha} > 0$, which is obviously the case, we still have a positive effect of productivity on γ in theory.
In order to test this assumption, I would have to empirically control for α. Since the admittedly broad literature on the productivity of public capital[27] calculates α as coefficients of production function regressions and thus there is no time series structure of the output elasticity of public capital, it is just a lack of data that prevents me from doing so.[28]
Apart from this, the effects of the significant control variables in table 4.3 are the same as in chapter 3.

Turning to the question of whether the model describes the advanced nations' governments' behavior rather than that of poorer countries, I again divide the sample according to income. As the tables c.4 and c.5 in the appendix show the results do not change compared to the basic model: whereas the positive effect of the TFP on γ^c is found in both sub-samples the negative influence of the age structure can only be found for the rich countries in a significant manner. Thus, also the extended model seems to better illustrate the choices of advanced countries' policymakers.

Summing up, the results of the empirical investigation of the changes that have been induced by the introduction of endogenous default costs are rather weak. Employing the

[26] As described in section 3.4 the lack in significance in column 1 and 2 is mainly driven by the existence of a common effect of TFP and GDP per capita. $lnA1$ just picks up the negative influence of GDP per capita.
[27] See Bom and Ligthart (2014) for an overview.
[28] E.g. Kamps (2006) offers estimations of α for 22 OECD countries.

TFP measure for A very much confirms the results of the basic model, whereas the use of the measure of the productivity of public capital replicates some new insights of the *commitment effect* augmented model, especially the newly seen negative impact of A on the investment share q. Ultimately, the theoretical model does not prefer any of the two interpretations of A, so there is also no decision to be made on which of those measures is better in the sense that it is closer to either the model or reality.

However, in almost all of the above specifications I do find the predicted effects of ω on the respective dependent variables. This approves the view of the age structure being *the* or at least *a* main determinant of the link between q and s. Although this is not in contrast to the basic model, the weight of the other country characteristics may be overrated there.

4.4 Conclusion

In this chapter I introduced the new *commitment effect* to the model presented in chapter 2. By relaxing the assumption of exogenously defined maximum default costs (b) and determining them endogenously instead, a country's policymaker by choosing the national expenditure mix now has some control about its creditworthiness at the international debt market and therewith is able to influence the price of foreign liabilities. In other words, if a government channels a lot of its funds into public investment projects it will likely be able to repay its debt with the future returns from these projects, i.e. generate a higher income. In the present stationary model, this serves as a *commitment* for a higher likelihood of repayment for the foreign investors and allows the domestic government to borrow more abroad. In equilibrium, this creates a new dependency of the foreign debt stock/foreign deficit on the productivity of public investment, and a – a priori counter-intuitive – negative impact of the latter on the share of public investment in total public expenditure q. Ultimately, the key variable in the model – i.e. the relationship of q and the foreign debt share s – is due to the *commitment effect* no longer depending on the country's productivity.

This in turn makes the age structure of a nation the main (and only) country characteristic that explains the variation in γ^c across countries. I find descriptive support for this

hypothesis in the data, indicating that older societies exhibit a less positive correlation of q and s. Also the regression results confirm the strongly negative impact of the age distribution.
However, these findings do not contrast the basic model. The novelty of the introduction of endogenous default costs instead lies in the result that a country's productivity no longer has an impact on γ. Therefor, the data show only limited evidence. Either the inclusion of a measure for the TFP or for the productivity of public capital – which are both applicable from a theoretical point of view – matter for the determination of the relationship of q and s.
Concerning the two other changes that are caused by the *commitment effect* in equilibrium, I find at least some empirircal evidence by employing the public capital productivity measure, that the latter has the theoretically predicted negative impact on the share of public investment in public expenditure as well as the predicted positive effect on foreign debt.

All in all, I enriched the basic model by an effect that is providing us with further insights of the relationship between a government's expenditure profile and the way it funds these expenses. Additionally, the introduction of the *commitment effect* can explain some of the surprising empirical results in chapter 3 due to changes in the comparative statics of the equilibrium values of the policymakers choice variables. However, not all of the predicted effects from theory can be found in the data which leaves room for further investigation into this relationship.

5 | Conclusion

This thesis has shed light on an angle of fiscal policy that has never been investigated in the economic literature so far: Whereas there is a wide range of studies that deal with the public debt burden in various ways (fiscal balance, debt composition in terms of maturity and currency, debt limits/overhang, growth effects of debt, ...) the ownership structure is often neglected. But as the recent Argentinian default on external debt and the denial of the involved US investors to agree on the haircut shows, governments are able to treat foreign and domestic obligations differently. For Argentina this resulted in direct costs in the form of the seizure of their assets in the US. Such a procedure would not be possible for domestic debt holders. Thus, even for the advanced nations the ownership of public debt matters – just recall the Greek debt restructurings in recent years.
However, while some scientific studies do investigate these debt issues, they do not account for the fact that the policymaker's decision about where to raise funds has to be executed at the same time as the choice of public expenditure, namely how much and for what to spend the acquired funds. Therefore, these decisions may well be linked with each other.

In this work I employed an 2 period OLG model to analyze the nature of this interconnection and detected three main country characteristics that exogenously determine the public spending behavior and debt profile simultaneously: the total factor productivity, the vulnerability in case of default, and the age structure of the domestic residents.
In the theoretical model an old and a young cohort differ with respect to their desired level of foreign debt as well as public investment. This is taken into account by the government's objective function and thus the relative size of the generations (or alternatively: the relative political influence they have) matters for the political outcome: the larger the

group of the older residents the less will be invested publicly – the government's revenue is rather used for public transfers. Additionally, the older the age structure of a society the more will the policymaker rely on externally rather than domestically issued debt, which is driven by the fact that members of the older cohort do not care about the future decision to repay foreign obligations, but just gain utility from today's (foreign debt financed) transfers and therewith consumption.

As for the vulnerability in case of default the effect on the public financing decision is straightforward: the more a country has to lose, the less likely this very event will occur. In turn, this has a positive effect on the conditions (volume and interest rate) at which a government can borrow abroad and induces the latter to make more use of external funds. On the other hand, the model shows that these additional funds are rather used for public transfers than investment, therewith driving down the public investment quota.

On the contrary, the productivity of a country, i.e. the rate at which a certain input is turned into output, exerts a positive influence on public investment, making it more attractive the higher the TFP is. As more investment generates more income, also the scope for domestic debt widens, and thus, foreign borrowing is lower.

To illustrate the relationship between the public spending choice and the debt issuance decision, I finally construct a measure (γ) that links the public investment share and the external debt quota. Since the government's decisions are both influenced by the three characteristics, also this measure is driven by these factors. In fact, it is positively affected by the productivity and negatively by the maximum default costs as well as the age structure.

The effects of the country characteristics that emerge from the theoretical analysis are then validated using a dataset that builds up on Panizza (2008). In general, the positive impact of the productivity on the country's public expenditure pattern can be found in the data on a very significant basis. The same holds for the negative effect of a society's age distribution. Rather insignificant results are derived for the influence of the vulnerability in case of default, though.

The latter variable also seems to have no significant impact on the debt structure of a country. However, the other two characteristics again show the theoretically derived effects on the foreign debt quota: higher productivity results in lower external debt shares whereas the opposite is the case for relatively old societies.

Combining both quotas, the strongly positive influence of the TFP can also be found empirically for γ, indicating that governments in more productive countries spend relatively more on public investment and finance these expenses via relatively less foreign funds. On the contrary, the impact of the relative size of the age groups affects γ in the opposite way: older societies force their policymakers to spend relatively more on public transfers and issue relatively more debt abroad. Also for the combining measure γ the influence of the maximum default costs is empirically not significant.

The third chapter additionally shows that the theoretical model seems to describe the political decisionmaking best for advanced countries. In a sub-sample of high income nations the predicted effects gain in significance compared to the full sample, whereas for the poorer countries the directions of the marginal effects remain, but the significancies decrease.

The fourth chapter then draws on the result, that I could not detect an empirical effect of the possible maximum default costs on both government's decisions. The assumption that this is an exogenously determined parameter is relaxed. This is motivated by the notice that a policymaker's expenditure behavior may serve as a signal for foreign lenders about the country's future ability to repay external debt, which would then affect the borrowing conditions. If the domestic government takes this into account, it can positively influence the terms of foreign debt by committing to an investment prone expenditure scheme.

This novelty brings some major changes to the equilibrium values of the choice variables compared to the basic model in chapter 2: first, the decision about how much to borrow abroad is now also (positively) depending on the productivity of a country, since more future outcome raises the government's incentives to invest, which increases the default costs and thus makes this event less likely. Therefore, external creditors are willing to lend more at – in equilibrium – the same interest rate as before. This is the *commitment effect*. However, and this is the second innovation to the basic model, these additional funds will be channeled mainly into public transfers, which makes the public investment quota going down the higher the TFP.

Finally, the linking measure γ^c is no longer affected by the country's productivity. This comes from the fact that with the introduction of the *commitment effect* the public investment quota as well as the share of foreign debt are both influenced in the same way by the TFP. Thus, as γ^c is defined as the ratio of both quotas, the marginal effect of the productivity cancels out. As a result, the remaining key characteristic that drives γ^c is the age distribution.
The empirical evidence of these three novelties is rather poor. But this is not very surprising given the strong results in chapter 3. However, the regressional analysis as well as descriptive comparisons confirm the effects of the age structure on both public decisions as well as on the linking measure γ^c.
Furthermore, the observation that this model captures the performance of rich countries' governments best, holds also for the *commitment effect* augmented version.

Altogether, this work has shown that the policymaker's decisions about where to issue debt and how to spend these funds are indeed linked. As the model, the empirical analysis, and the extended model point out this link is not necessarily to be understood as a causal relationship but rather constituted by the fact that both choices are influenced by exogenous factors. However, this should not be read as a license for politicians that justifies all their expenditure and debt issuing behavior. Instead, it rather documents the government's way to influence both quotas (e.g. via the *commitment effect*) and thus should help to understand wealth maximizing spending and borrowing patterns.
As this work is the first to explore the simultaneous public decisions, it has to be seen as paving the road for a deeper analysis of these processes. Therefore, the presented model provides a lot of starting points: for example the introduction of a political voting mechanism with possible changes of government would enable to deeply delve into the political component of the topic. Another extension could be the implementation of further factors of production (labor, human capital, private capital) and the respective markets of these factors, in order to investigate the consequences of government behavior on private supply of these factors, that are potentially competing with public capital in the production process. One could also think of transferring the model to a more dynamic basis by adding periods and introducing (income)shocks that would allow to analyze effects of e.g. the

recent sovereign debt crisis.

All these links could finally lead towards a better understanding of the interconnections of political decisionmaking and therewith result in more growth and wealth enhancing policymaking that may also allow governments to prevent future crisis at an early stage.

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A Appendix: The political-economy approach

Proof of Lemma 2.1

In this appendix, we show that the government's default condition (2.10) can be simplified to the relation pinned down by Lemma 2.1. To save on notation, we denote variables that are chosen in period t after a default has occurred by using the superscript $'$. Conversely, we use the superscript $^{-}$ if no default took place. Accordingly, in the following period this leads to the superscript $''$ under a defaulting regime in $t+1$ and $^{=}$ for no default.

We claim that there is a threshold level $\hat{\zeta}_t$ that indicates the turning point at which a government would "switch" from repayment to default. Using (2.10), this threshold turns out to be

$$\begin{aligned}\hat{\zeta}_t =& \frac{1}{2} R_t^F D_t^F + \frac{1}{2}(\overbrace{D_{t+1}^{F'} - D_{t+1}^{F-}}^{k}) + \frac{1}{2}(\overbrace{K_{t+1}^{G-} - K_{t+1}^{G'}}^{l}) \\ &+ \frac{(1-\omega)}{2\omega} E_t \Big[2(\underbrace{Y_{t+1}(K_{t+1}^{G'}) - Y_{t+1}(K_{t+1}^{G-})}_{m}) + (\underbrace{D_{t+2}^{F''}{}' - D_{t+2}^{F''-}}_{n}) + (\underbrace{K_{t+2}^{G''-} - K_{t+2}^{G''}{}'}_{o}) \Big]\end{aligned}$$

Note that we assume that a default takes place in period $t+1$ ($D_{t+2}^{F''}{}'$ and $K_{t+2}^{G''}{}'$). The alternative assumption of repayment in period $t+1$ ($D_{t+2}^{F=}{}'$ and $K_{t+2}^{G=}{}'$) would be inconsequential for our results.

We now have to prove, that $k = l = m = 0$ and $n = o = 0$.

Starting with n and o, i.e showing the independence of the government's decisions about foreign debt and investment expenses in $t+1$ from the default decision in t, we compute the derivation of the government's utility function (2.9) in period $t+1$ if default took place in t:

$$\begin{aligned} V_{t+1}^{G''\prime} =& 2\omega(Y_{t+1}(K_{t+1}^{G'}) - \zeta_{t+1}) + \omega(D_{t+2}^{F''\prime} - K_{t+2}^{G''\prime}) \\ & + (1-\omega)\beta\Big[2Y_{t+2}(K_{t+2}^{G''\prime}) + \int_0^{\hat{\zeta}_{t+2}} \Big(D_{t+3}^{F'''} - K_{t+3}^{G'''} - 2\zeta_{t+2}\Big) dF(\zeta_{t+2}) \\ & + \int_{\hat{\zeta}_{t+2}}^{b} \Big(D_{t+3}^{F\equiv} - K_{t+3}^{G\equiv} - R_{t+2}^{''\prime} D_{t+2}^{F''\prime}\Big) dF(\zeta_{t+2})\Big] \end{aligned}$$

Equivalently, for no default in period t the objective function of the government in $t+1$ is:

$$\begin{aligned} V_{t+1}^{G''-} =& 2\omega(Y_{t+1}(K_{t+1}^{G-}) - \zeta_{t+1}) + \omega(D_{t+2}^{F''-} - K_{t+2}^{G''-}) \\ & + (1-\omega)\beta\Big[2Y_{t+2}(K_{t+2}^{G''-}) + \int_0^{\hat{\zeta}_{t+2}} \Big(D_{t+3}^{F'''} - K_{t+3}^{G'''} - 2\zeta_{t+2}\Big) dF(\zeta_{t+2}) \\ & + \int_{\hat{\zeta}_{t+2}}^{b} \Big(D_{t+3}^{F\equiv} - K_{t+3}^{G\equiv} - R_{t+2}^{''-} D_{t+2}^{F''-}\Big) dF(\zeta_{t+2})\Big] \end{aligned}$$

Since the only difference in these objective functions is the appearance of $K_{t+1}^{G'}$ and K_{t+1}^{G-}, which due to the linearity of the functions do not matter for the choice of optimal values of foreign debt $D_{t+2}^{F''}$ and investment $K_{t+2}^{G''}$, this is a proof for the independence of future governments' choices of today's default decision, in particular $D_{t+2}^{F''\prime} = D_{t+2}^{F''-}$ and $K_{t+2}^{G''-} = K_{t+2}^{G''\prime}$.[1]

Next, we show that in the above formula $k = l = m = 0$.
The government's utility (2.9) in period t for the case of default is

[1] Note that this not necessarily implies identical levels for internal debt ($D_{t+2}^{H''\prime} = D_{t+2}^{H''-}$) or transfers ($T_{t+1}^{''\prime} = T_{t+1}^{''-}$).

$$
\begin{aligned}
V_t^{G\prime} =& 2\omega(Y_t - \zeta_t) + \omega(D_{t+1}^{F'} - K_{t+1}^{G'}) \\
&+ (1-\omega)\beta\Big[2Y_{t+1}(K_{t+1}^{G'}) + \int_0^{\hat{\zeta}_{t+1}} \Big(D_{t+2}^{F''} - K_{t+2}^{G''} - 2\zeta_{t+1}\Big) dF(\zeta_{t+1}) \\
&+ \int_{\hat{\zeta}_{t+1}}^{b} \Big(D_{t+2}^{F=} - K_{t+2}^{G=} - R_{t+1}^{'} D_{t+1}^{F'}\Big) dF(\zeta_{t+1})\Big].
\end{aligned}
$$

If the policymaker opts for repayment in period t, we get

$$
\begin{aligned}
V_t^{G-} =& 2\omega(Y_t - \frac{1}{2}R_t D_t^F) + \omega(D_{t+1}^{F-} - K_{t+1}^{G-}) \\
&+ (1-\omega)\beta\Big[2Y_{t+1}(K_{t+1}^{G-}) + \int_0^{\hat{\zeta}_{t+1}} \Big(D_{t+2}^{F''} - K_{t+2}^{G''} - 2\zeta_{t+1}\Big) dF(\zeta_{t+1}) \\
&+ \int_{\hat{\zeta}_{t+1}}^{b} \Big(D_{t+2}^{F=} - K_{t+2}^{G=} - R_{t+1}^{-} D_{t+1}^{F-}\Big) dF(\zeta_{t+1})\Big],
\end{aligned}
$$

It is obvious, that the optimal values for investment and external debt are the same in both cases, i.e. $\tilde{K}_{t+1}^{G'} = \tilde{K}_{t+1}^{G-}$ and $\tilde{D}_{t+1}^{F'} = \tilde{D}_{t+1}^{F-}$. Since R is a function of D^F, the same holds for $\tilde{R}_{t+1}^{'}$ and $\tilde{R}_{t+1}^{-}$. Therewith, it is proven, that $k = l = m = 0$ and that the government's default decision is determined by the condition stated in Lemma 2.1.

B Appendix: The empirical approach

B.1 Effects of A, b, and ω on the equilibrium values of the main choice variables

The following table summarizes the marginal effects of the three main country characteristics A (total factor productivity), b (maximum default costs), and ω (relative size of the older cohort) on the main choice variables of the basic model.

Variable	A	b	ω
$\tilde{K}^G$	+	0	-
$\tilde{Y}$	+	0	-
$\tilde{D}^F$	0	+	+
$\tilde{R}$	0	0	+

Table b.1: Sign of the derivatives of the main choice variables' equilibrium values with respect to A, b, and ω

B.1.1 Effects of A, b, and ω on q

As for the effects of the three main country characteristics on the public investment quota, I derive the following:

$$\begin{aligned}\frac{\partial \tilde{q}_t(\varphi_t = 0)}{\partial A} &= \frac{\frac{\partial \tilde{K}^G}{\partial A}(2\tilde{Y} + 2\tilde{D}^F - \tilde{K}^G - 2\zeta_t) - \tilde{K}^G(2\frac{\partial \tilde{Y}}{\partial A} - \frac{\partial \tilde{K}^G}{\partial A})}{\Omega_t^2(\varphi_t = 0)} \\ &= \frac{\frac{\partial \tilde{K}^G}{\partial A}(2\tilde{D}^F - 2\zeta_t)}{\Omega_t^2(\varphi_t = 0)} > 0\end{aligned} \tag{B.1.1}$$

Obviously, for the default case, there is a positive influence of A on q.[1]

If the government chooses repayment of debt, I get:

$$\begin{aligned}\frac{\partial \tilde{q}_t(\varphi_t=1)}{\partial A} &= \frac{\frac{\partial \tilde{K}^G}{\partial A}(2\tilde{Y}+2\tilde{D}^F-\tilde{K}^G-2\hat{\zeta}-\tilde{R}D_t^H)-\tilde{K}^G(2\frac{\partial \tilde{Y}}{\partial A}-\frac{\partial \tilde{K}^G}{\partial A})}{\Omega_t^2(\varphi_t=1)} \\ &= \frac{\frac{\partial \tilde{K}^G}{\partial A}(2\tilde{D}^F-2\hat{\zeta}-\tilde{R}D_t^H)}{\Omega_t^2(\varphi_t=1)}\end{aligned} \tag{B.1.2}$$

There is no clear-cut determination of the marginal effect of A for the case of repayment, since the expression in the bracket can be larger or smaller than 0.

Turning to the impact of b on the public investment quota:

$$\frac{\partial \tilde{q}_t(\varphi_t=0)}{\partial b} = \frac{-\tilde{K}^G(2\frac{\partial \tilde{D}^F}{\partial b})}{\Omega_t^2(\varphi_t=0)} < 0 \tag{B.1.3}$$

and

$$\frac{\partial \tilde{q}_t(\varphi_t=1)}{\partial b} = \frac{-\tilde{K}^G(2\frac{\partial \tilde{D}^F}{\partial b}-2\frac{\partial \hat{\zeta}}{\partial b})}{\Omega_t^2(\varphi_t=1)} < 0 \tag{B.1.4}$$

The equations above deliver an unambiguously negative effect: the more is at stake for a government in case of default, the (relatively) more it will spend on public transfers rather than investment.

Last, I analyze the effect of ω on the public investment quota:

[1] Recall, that $2\zeta_t < 2\hat{\zeta} = \tilde{R}\tilde{D}^F < 2\tilde{D}^F$.

$$\frac{\partial \tilde{q}_t(\varphi_t=0)}{\partial \omega} = \frac{\frac{\partial \tilde{K}^G}{\partial \omega}(2\tilde{Y}+2\tilde{D}^F-\tilde{K}^G-2\zeta_t)-\tilde{K}^G(2\frac{\partial \tilde{Y}}{\partial \omega}+2\frac{\partial \tilde{D}^F}{\partial \omega}-\frac{\partial \tilde{K}^G}{\partial \omega})}{\Omega_t^2(\varphi_t=0)} \tag{B.1.5}$$
$$= \frac{\left(\frac{\partial \tilde{K}^G}{\partial \omega}2\tilde{Y}-\tilde{K}^G 2\frac{\partial \tilde{Y}}{\partial \omega}\right)+\frac{\partial \tilde{K}^G}{\partial \omega}(2\tilde{D}^F-2\zeta_t)-\tilde{K}^G 2\frac{\partial \tilde{D}^F}{\partial \omega}}{\Omega_t^2(\varphi_t=0)} < 0$$

The overall impact in case of default is negative, since $(\frac{\partial \tilde{K}^G}{\partial \omega}2\tilde{Y}-\tilde{K}^G 2\frac{\partial \tilde{Y}}{\partial \omega}) < 0$ and $2\tilde{D}^F > \tilde{R}\tilde{D}^F = 2\zeta_t$.

For the repayment case there is no mathematically clear-cut proof of the sign of the following derivation:

$$\frac{\partial \tilde{q}_t(\varphi_t=1)}{\partial \omega} = \frac{\frac{\partial \tilde{K}^G}{\partial \omega}(2\tilde{Y}+2\tilde{D}^F-\tilde{K}^G-2\hat{\zeta}-\tilde{R}D_t^H)-\tilde{K}^G(2\frac{\partial \tilde{Y}}{\partial \omega}+2\frac{\partial \tilde{D}^F}{\partial \omega}-\frac{\partial \tilde{K}^G}{\partial \omega}-\frac{\partial \tilde{R}\tilde{D}^F}{\partial \omega}-\frac{\partial \tilde{R}}{\partial \omega}D_t^H)}{\Omega_t^2(\varphi_t=1)} \tag{B.1.6}$$

In analogy to the default case one might think of a negative marginal effect, but there is no analytical proof of this guess.

B.1.2 Effects of A, b, and ω on s

The equilibrium value of the foreign debt quota $\tilde{s}$ is depending on the economy's productivity through the level of domestic debt D^H (cf. equation (2.25) and (2.26)), and the marginal effects of A therefore look the following:

$$\frac{\partial \tilde{s}_t(\varphi_t=0)}{\partial A} = \frac{-\tilde{D}^F(2\frac{\partial \tilde{Y}}{\partial A}-\frac{\partial \tilde{K}^G}{\partial A})}{\Omega_t^2(\varphi_t=0)} < 0 \tag{B.1.7}$$

Since it can easily be demonstrated[2] that $(2\frac{\partial \tilde{Y}}{\partial A}-\frac{\partial \tilde{K}^G}{\partial A}) > 0$, in case of default a more productive country c.p. shows a lower foreign debt quota.

If the government opts for default, the same applies:

[2] Therefor, just plug in the derivatives of equation (2.16) and (2.17), respectively.

$$\frac{\partial \tilde{s}_t(\varphi_t = 1)}{\partial A} = \frac{-\tilde{D}^F(2\frac{\partial \tilde{Y}}{\partial A} - \frac{\partial \tilde{K}^G}{\partial A})}{\Omega_t^2(\varphi_t = 1)} < 0 \tag{B.1.8}$$

For the effect of the maximum default costs, I build the derivatives with respect to b:

$$\begin{aligned} \frac{\partial \tilde{s}_t(\varphi_t = 0)}{\partial b} &= \frac{\frac{\partial \tilde{D}^F}{\partial b}(2\tilde{Y} + 2\tilde{D}^F - \tilde{K}^G - 2\zeta_t) - \tilde{D}^F(2\frac{\partial \tilde{D}^F}{\partial b})}{\Omega_t^2(\varphi_t = 0)} \\ &= \frac{\frac{\partial \tilde{D}^F}{\partial b}(2\tilde{Y} - \tilde{K}^G - 2\zeta_t)}{\Omega_t^2(\varphi_t = 0)} > 0 \end{aligned} \tag{B.1.9}$$

and

$$\begin{aligned} \frac{\partial \tilde{s}_t(\varphi_t = 1)}{\partial b} &= \frac{\frac{\partial \tilde{D}^F}{\partial b}(2\tilde{Y} + 2\tilde{D}^F - \tilde{K}^G - 2\hat{\zeta} - \tilde{R}D_t^H) - \tilde{D}^F(2\frac{\partial \tilde{D}^F}{\partial b} - 2\frac{\partial \hat{\zeta}}{\partial b})}{\Omega_t^2(\varphi_t = 1)} \\ &= \frac{\frac{\partial \tilde{D}^F}{\partial b}(2\tilde{Y} - \tilde{K}^G - \tilde{R}D_t^H)}{\Omega_t^2(\varphi_t = 1)} > 0 \end{aligned} \tag{B.1.10}$$

While in case of default the overall impact of b is clearly positive, for the repayment case there is no mathematical proof that $(2\tilde{Y} - \tilde{K}^G - \tilde{R}D_t^H) > 0$. However, going one step back to the definition of $\tilde{s}_t(\varphi_t = 1) = \frac{\tilde{D}^F}{\tilde{D}^F + \tilde{D}_{t+1}^H(\varphi_t = 1)}$, one can show that on the one hand $\frac{\partial \tilde{D}^F}{\partial b} > 0$ and on the other hand $\frac{\partial \tilde{D}^H(\varphi_t = 1)}{\partial b} = \frac{\partial \tilde{D}^F}{\partial b} - 2\frac{\partial \hat{\zeta}}{\partial b} = \frac{\partial \tilde{D}^F}{\partial b} - \tilde{R}\frac{\partial \tilde{D}^F}{\partial b} < 0$, which in turn implies also a positive effect of b on the foreign debt quota in case of repayment.

Last, I look at the link between s and the demographic variable ω:

$$\begin{aligned} \frac{\partial \tilde{s}_t(\varphi_t = 0)}{\partial \omega} &= \frac{\frac{\partial \tilde{D}^F}{\partial \omega}(2\tilde{Y} + 2\tilde{D}^F - \tilde{K}^G - 2\zeta_t) - \tilde{D}^F(2\frac{\partial \tilde{Y}}{\partial \omega} + 2\frac{\partial \tilde{D}^F}{\partial \omega} - \frac{\partial \tilde{K}^G}{\partial \omega})}{\Omega_t^2(\varphi_t = 0)} \\ &= \frac{\frac{\partial \tilde{D}^F}{\partial \omega}(2\tilde{Y} - \tilde{K}^G - 2\zeta_t) - \tilde{D}^F(2\frac{\partial \tilde{Y}}{\partial \omega} - \frac{\partial \tilde{K}^G}{\partial \omega})}{\Omega_t^2(\varphi_t = 0)} > 0 \end{aligned} \tag{B.1.11}$$

It can be proved that $2\frac{\partial \tilde{Y}}{\partial \omega} - \frac{\partial \tilde{K}^G}{\partial \omega} < 0$, and additionally we know from the model settings that the default is only chosen if $2\zeta_t < 2\hat{\zeta} = 2\frac{b}{2}(1 - \frac{1}{z}) < b < \tilde{Y}$. This indicates together with $\tilde{Y} > \tilde{K}^G$ that the foreign debt quota is higher for older societies in case of default.

$$\frac{\partial \tilde{s}_t(\varphi_t = 1)}{\partial \omega} = \frac{\frac{\partial \tilde{D}^F}{\partial \omega}(2\tilde{Y} + 2\tilde{D}^F - \tilde{K}^G - 2\hat{\zeta} - \tilde{R}D_t^H) - \tilde{D}^F(2\frac{\partial \tilde{Y}}{\partial \omega} + 2\frac{\partial \tilde{D}^F}{\partial \omega} - \frac{\partial \tilde{K}^G}{\partial \omega} - \frac{\partial \tilde{R}\tilde{D}^F}{\partial \omega} - \frac{\partial \tilde{R}}{\partial \omega}D_t^H)}{\Omega_t^2(\varphi_t = 1)} \tag{B.1.12}$$

$$= \frac{\frac{\partial \tilde{D}^F}{\partial \omega}(2\tilde{Y} + \tilde{D}^F - \tilde{K}^G - 2\hat{\zeta} - \tilde{R}D_t^H)}{\Omega_t^2(\varphi_t = 1)} - \frac{\tilde{D}^F\Big([2\frac{\partial \tilde{Y}}{\partial \omega} - \frac{\partial \tilde{K}^G}{\partial \omega}] + \{\frac{\partial \tilde{D}^F}{\partial \omega} - \tilde{R}\frac{\partial \tilde{D}^F}{\partial \omega}\} - \frac{\partial \tilde{R}}{\partial \omega}\tilde{D}^F - \frac{\partial \tilde{R}}{\partial \omega}D_t^H\Big)}{\Omega_t^2(\varphi_t = 1)} > 0$$

For the non-default case the overall effect of ω is also positive. Mathematically spoken, the expression $(2\tilde{Y} + \tilde{D}^F - \tilde{K}^G - 2\hat{\zeta} - \tilde{R}D_t^H)$ is just the equilibrium value of $\tilde{D}_{t+1}^H(\varphi_t = 1)$, which is by assumption > 0. Moreover, all the summands[3] in the last line of (B.1.12) enter the entire expression negatively, resulting in an overall positive impact.

[3] The terms in the smaller brackets are considered one *summand* each.

B.2 Data

Variable	Source	Description
K^G	*OECD, Eurostat, WDI*	Pubilc gross fixed capital formation
T	*WEO*	Social security benefits
q	$= \frac{K^G}{K^G+T}$	Public investment quota
D^F	*Panizza (2008), Cowan et al. (2006), QPSDS*	Outstanding foreign debt
D^H	*Panizza (2008), Cowan et al. (2006)*	Outstanding domestic debt
s	$= \frac{D^F}{D^F+D^H}$	Foreign debt quota
A1	*Inter-American Development Bank*	Total factor productivity
capprod_pub	*Penn World Tables*	Public capital productivity ($= \frac{GDP}{K^{pub}}$)
Macap	*WDI, World federation of exchanges*	Market capitalization of listed companies
Adr	*WDI*	Age dependency ratio, old (% of working-age population)
GDPpc	*WDI*	Gross domestic product per capita
GvtExp	*WDI*	Total central government expenditure
Inst	*International Country Risk Guide*	Index (0=high level of corruption & bureaucracy, 1=low ...)
Debt	*Panizza (2008), Cowan et al. (2006), QPSDS*	Total outstanding debt
GvtBal	*WEO*	Central government balance (% of GDP)
TaxRev	*WDI*	Central government tax Revenue (% of GDP)
Infl	*WDI*	Consumer price index
SavingR	*WDI*	Gross domestic saving rate
Depr	*Penn World Tables*	Average depriciation rate of the capital stock
CaBal	*WEO*	Current account balance (% of GDP)
Trade	*WDI*	Tradeopenness ($\frac{Exports-Imports}{GDP}$)

Table b.2: Data sources and description

B.3 Additional regression tables

	(1) lnQ b/se	(2) lnQ b/se	(3) lnQ b/se	(4) lnQ b/se	(5) lnQ b/se	(6) lnQ b/se
lnA1	1.158**	0.631			1.084***	
	(0.44)	(0.37)			(0.33)	
lnCapprod_pub						-0.494***
						(0.11)
lnMacap	0.015		-0.043		-0.029	0.008
	(0.04)		(0.04)		(0.05)	(0.04)
lnAdr	-1.267***			-0.973**	-1.203***	-1.031**
	(0.27)			(0.43)	(0.42)	(0.42)
lnGdpPc	-0.419*					0.310
	(0.23)					(0.27)
lnGvtExp	0.307					-0.070
	(0.21)					(0.23)
lnInst	0.074					-0.246*
	(0.20)					(0.14)
lnDebt	-0.045					-0.203**
	(0.06)					(0.08)
lnGvtBal	0.044*					0.066***
	(0.02)					(0.02)
lnTaxRev	-0.137					-0.092
	(0.13)					(0.14)
lnInfl	0.024					0.029
	(0.03)					(0.02)
lnSavingR	0.077***					0.158***
	(0.02)					(0.04)
lnDepr	0.182					0.129
	(0.36)					(0.40)
lnCaBal	-0.041**					-0.049***
	(0.02)					(0.02)
lnTrade	0.056					0.047
	(0.16)					(0.14)
_cons	-7.727***	-5.460**	-1.637***	-3.356***	-10.405***	-5.305*
	(2.65)	(2.29)	(0.03)	(0.78)	(2.54)	(2.64)
R^2	0.339	0.032	0.014	0.072	0.153	0.546
Observations	292	292	292	292	292	292
Countries	31	31	31	31	31	31

* p<0.1, ** p<0.05, *** p<0.01

Table b.3: Public investment quota with sample from table 3.2 (column 5), FE

	(1)	(2)	(3)	(4)
	lnQ	lnQ	lnQ	lnQ
	b/se	b/se	b/se	b/se
lnA1	1.158**			
	(0.44)			
L.lnA1		1.387**		
		(0.61)		
lnCapprod_pub			-0.557***	
			(0.08)	
L.lnCapprod_pub				-0.274***
				(0.08)
lnMacap	0.015		0.007	
	(0.04)		(0.02)	
L.lnMacap		0.031		0.021
		(0.04)		(0.03)
lnAdr	-1.267***		-1.235***	
	(0.27)		(0.41)	
L.lnAdr		-1.135***		-1.052**
		(0.37)		(0.40)
lnGdpPc	-0.419*		0.465***	
	(0.23)		(0.17)	
L.lnGdpPc		-0.442		0.218
		(0.29)		(0.16)
lnGvtExp	0.307		-0.103	
	(0.21)		(0.18)	
L.lnGvtExp		-0.051		-0.192
		(0.18)		(0.20)
lnInst	0.074		-0.233**	
	(0.20)		(0.11)	
L.lnInst		0.018		-0.180*
		(0.16)		(0.10)
lnDebt	-0.045		-0.224***	
	(0.06)		(0.05)	
L.lnDebt		-0.041		-0.143**
		(0.06)		(0.06)
lnGvtBal	0.044*		0.070***	
	(0.02)		(0.02)	
L.lnGvtBal		0.023		0.046***
		(0.02)		(0.02)
lnTaxRev	-0.137		0.066	
	(0.13)		(0.11)	
L.lnTaxRev		-0.088		0.022
		(0.12)		(0.09)
lnInfl	0.024		0.043***	
	(0.03)		(0.01)	
L.lnInfl		-0.007		0.009
		(0.03)		(0.02)
lnSavingR	0.077***		0.179***	
	(0.02)		(0.03)	
L.lnSavingR		0.068***		0.121***
		(0.01)		(0.02)
lnDepr	0.182		0.216	
	(0.36)		(0.42)	
L.lnDepr		-0.344		-0.226
		(0.47)		(0.50)
lnCaBal	-0.041**		-0.044***	
	(0.02)		(0.01)	
L.lnCaBal		-0.039**		-0.034**
		(0.01)		(0.01)
lnTrade	0.056		-0.014	
	(0.16)		(0.12)	
L.lnTrade		0.104		0.111
		(0.16)		(0.13)
_cons	-7.727***	-9.431***	-6.265***	-5.733**
	(2.65)	(2.91)	(2.08)	(2.68)
R^2	0.339	0.313	0.613	0.287
Observations	292	298	412	404
Countries	31	33	45	46

* p<0.1, ** p<0.05, *** p<0.01

Table b.4: Public investment quota with lagged controls, FE

	(1) lnS b/se	(2) lnS b/se	(3) lnS b/se	(4) lnS b/se
lnA1	-2.962***			
	(0.91)			
L.lnA1		-2.578***		
		(0.91)		
lnCapprod_pub			0.009	
			(0.09)	
L.lnCapprod_pub				0.049
				(0.09)
lnMacap	-0.032		-0.048	
	(0.05)		(0.04)	
L.lnMacap		0.023		-0.001
		(0.05)		(0.04)
lnAdr	0.570		-0.270	
	(1.04)		(0.82)	
L.lnAdr		-0.027		-0.779
		(1.09)		(0.84)
lnGdpPc	0.766		-0.396	
	(0.50)		(0.24)	
L.lnGdpPc		0.838		-0.278
		(0.57)		(0.28)
lnGvtExp	0.108		0.335*	
	(0.18)		(0.19)	
L.lnGvtExp		-0.067		0.106
		(0.18)		(0.21)
lnInst	-0.506**		-0.372	
	(0.23)		(0.24)	
L.lnInst		-0.512**		-0.342
		(0.25)		(0.23)
lnDebt	-0.259*		0.061	
	(0.13)		(0.08)	
L.lnDebt		-0.248**		0.047
		(0.12)		(0.08)
lnGvtBal	0.086*		0.081**	
	(0.05)		(0.04)	
L.lnGvtBal		0.074		0.071
		(0.05)		(0.04)
lnTaxRev	-0.768***		-0.497**	
	(0.25)		(0.21)	
L.lnTaxRev		-0.615**		-0.460**
		(0.25)		(0.21)
lnInfl	0.103**		0.058	
	(0.05)		(0.04)	
L.lnInfl		0.080		0.047
		(0.05)		(0.04)
lnSavingR	-0.006		-0.018	
	(0.03)		(0.03)	
L.lnSavingR		0.029		-0.002
		(0.02)		(0.03)
lnDepr	-0.634		-0.142	
	(0.71)		(0.77)	
L.lnDepr		-0.514		-0.247
		(0.74)		(0.80)
lnCaBal	-0.013		-0.026	
	(0.03)		(0.03)	
L.lnCaBal		-0.038		-0.038
		(0.03)		(0.03)
lnTrade	0.143		0.016	
	(0.27)		(0.31)	
L.lnTrade		-0.119		-0.106
		(0.28)		(0.30)
_cons	7.521*	5.573	-0.807	-1.919
	(4.43)	(4.95)	(3.77)	(4.15)
R^2	0.230	0.213	0.100	0.100
Observations	432	398	562	507
Countries	48	47	64	63

* p<0.1, ** p<0.05, *** p<0.01

Table b.5: Foreign debt quota with lagged controls, FE

	(1)	(2)	(3)	(4)	(5)
	lnS	lnS	lnS	lnS	lnS
	b/se	b/se	b/se	b/se	b/se
lnA1	-2.962***	-1.560**			-1.521*
	(0.91)	(0.76)			(0.82)
lnCapprod_pub					
lnMacap	-0.032		-0.085		-0.032
	(0.05)		(0.08)		(0.05)
lnAdr	0.570			-0.833	0.100
	(1.04)			(0.93)	(1.06)
lnGdpPc	0.766				
	(0.50)				
lnGvtExp	0.108				
	(0.18)				
lnInst	-0.506**				
	(0.23)				
lnDebt	-0.259*				
	(0.13)				
lnGvtBal	0.086*				
	(0.05)				
lnTaxRev	-0.768***				
	(0.25)				
lnInfl	0.103**				
	(0.05)				
lnSavingR	-0.006				
	(0.03)				
lnDepr	-0.634				
	(0.71)				
lnCaBal	-0.013				
	(0.03)				
lnTrade	0.143				
	(0.27)				
_cons	7.521*	8.188*	-1.127***	-2.789	8.135
	(4.43)	(4.49)	(0.08)	(1.96)	(6.25)
R^2	0.230	0.074	0.016	0.019	0.076
Observations	432	432	432	432	432
Countries	48	48	48	48	48

* p<0.1, ** p<0.05, *** p<0.01

Table b.6: Foreign debt quota with sample from table 3.4 (column 5), FE

	(1)	(2)	(3)	(4)	(5)
	lnS	lnS	lnS	lnS	lnS
	b/se	b/se	b/se	b/se	b/se
lnCapprod_pub	0.031			0.069	0.009
	(0.03)			(0.06)	(0.09)
lnMacap		-0.077***		-0.046*	-0.048
		(0.03)		(0.02)	(0.04)
lnAdr			-0.412	-0.661	-0.270
			(0.41)	(0.72)	(0.82)
lnGdpPc					-0.396
					(0.24)
lnGvtExp					0.335*
					(0.19)
lnInst					-0.372
					(0.24)
lnDebt					0.061
					(0.08)
lnGvtBal					0.081**
					(0.04)
lnTaxRev					-0.497**
					(0.21)
lnInfl					0.058
					(0.04)
lnSavingR					-0.018
					(0.03)
lnDepr					-0.142
					(0.77)
lnCaBal					-0.026
					(0.03)
lnTrade					0.016
					(0.31)
_cons	-0.795***	-1.053***	-1.718*	-2.467	-0.807
	(0.02)	(0.04)	(0.95)	(1.52)	(3.77)
R^2	0.001	0.021	0.006	0.033	0.100
Observations	1472	1351	2056	1057	562
Countries	108	100	134	80	64

* p<0.1, ** p<0.05, *** p<0.01

Table b.7: Foreign debt quota and public capital productivity, FE

	(1)	(2)
	lnQ	lnQ
	b/se	b/se
lnQ		
lnA1	-0.162***	
	(0.03)	
lnCapprod_pub		-0.402***
		(0.02)
lnMacap	0.151***	0.126***
	(0.02)	(0.01)
lnAdr	-1.247***	-1.510***
	(0.04)	(0.02)
lnS		
lnA1	-0.714***	
	(0.03)	
lnCapprod_pub		0.973***
		(0.03)
lnMacap	-0.118***	-0.281***
	(0.02)	(0.01)
lnAdr	-0.166***	-0.229***
	(0.04)	(0.02)
Observations	340	510

* p<0.1, ** p<0.05, *** p<0.01

Table b.8: Public investment and foreign debt quota as seemingly unrelated regressions

	(1) SUR1 b/se	(2) SUR2 b/se
lnQ		
lnA1	-0.017	
	(4.69)	
lnCapprod_pub		-0.691***
		(0.07)
lnMacap	0.093	0.063*
	(0.34)	(0.04)
lnAdr	-0.534	-0.663
	(9.97)	(0.42)
lnGdpPc	-0.304	-0.241
	(2.86)	(0.37)
lnGvtExp	-0.519	-0.486
	(2.56)	(0.41)
lnInst	0.104	-0.090
	(2.05)	(0.50)
lnDebt	-0.021	0.101
	(2.08)	(0.28)
lnGvtBal	0.006	0.206***
	(0.15)	(0.04)
lnTaxRev	-0.237	0.147
	(1.95)	(0.32)
lnInfl	0.017	-0.054**
	(0.24)	(0.03)
lnSavingR	0.070	0.106***
	(0.08)	(0.02)
lnDepr	-0.078	-0.273
	(6.29)	(0.30)
lnCaBal	-0.013	-0.038
	(0.24)	(0.02)
lnTrade	0.239	0.078
	(0.99)	(0.30)
lnS		
lnA1	-0.219	
	(4.37)	
lnCapprod_pub		0.368
		(0.34)
lnMacap	-0.124	-0.225
	(0.68)	(0.17)
lnAdr	0.191	0.221
	(1.99)	(1.66)
lnGdpPc	-0.028	-0.265
	(2.22)	(1.24)
lnGvtExp	0.525	0.760
	(1.80)	(1.66)
lnInst	-0.277	-0.364
	(2.14)	(2.39)
lnDebt	-0.149	0.022
	(0.88)	(1.25)
lnGvtBal	0.180	0.029
	(0.18)	(0.18)
lnTaxRev	-0.451	-0.147
	(2.06)	(1.46)
lnInfl	0.012	0.063
	(0.18)	(0.10)
lnSavingR	-0.092	-0.185**
	(0.09)	(0.08)
lnDepr	0.422	0.434
	(3.16)	(1.15)
lnCaBal	-0.084	0.019
	(0.17)	(0.12)
lnTrade	0.210	0.161
	(1.16)	(1.31)
Observations	251	362

* p<0.1, ** p<0.05, *** p<0.01

Table b.9: Public investment and foreign debt quota as SUR with controls

	(1) lnGamma b/se	(2) lnGamma b/se	(3) lnGamma b/se	(4) lnGamma b/se
lnA1	4.315***			
	(1.05)			
L.lnA1		3.804***		
		(1.23)		
lnCapprod_pub			-0.815***	
			(0.18)	
L.lnCapprod_pub				-0.539***
				(0.19)
lnMacap	0.189		0.126	
	(0.14)		(0.08)	
L.lnMacap		0.119		0.110
		(0.12)		(0.08)
lnAdr	-3.190***		-2.810**	
	(1.08)		(1.09)	
L.lnAdr		-3.038**		-2.240*
		(1.43)		(1.16)
lnGdpPc	-2.194***		0.343	
	(0.71)		(0.38)	
L.lnGdpPc		-2.275***		-0.024
		(0.78)		(0.39)
lnGvtExp	-0.065		-0.851	
	(0.59)		(0.60)	
L.lnGvtExp		0.096		-0.584
		(0.61)		(0.62)
lnInst	0.212		-0.473	
	(0.52)		(0.32)	
L.lnInst		0.273		-0.365
		(0.49)		(0.28)
lnDebt	-0.093		-0.429***	
	(0.19)		(0.09)	
L.lnDebt		-0.002		-0.326***
		(0.15)		(0.10)
lnGvtBal	-0.013		0.014	
	(0.06)		(0.06)	
L.lnGvtBal		-0.010		-0.005
		(0.05)		(0.05)
lnTaxRev	0.704		0.810***	
	(0.45)		(0.20)	
L.lnTaxRev		0.586		0.847***
		(0.37)		(0.24)
lnInfl	-0.047		0.023	
	(0.07)		(0.03)	
L.lnInfl		-0.027		0.024
		(0.06)		(0.03)
lnSavingR	0.057		0.243***	
	(0.04)		(0.06)	
L.lnSavingR		0.017		0.162***
		(0.03)		(0.05)
lnDepr	0.740		0.515	
	(1.09)		(1.15)	
L.lnDepr		0.310		0.245
		(1.15)		(1.12)
lnCaBal	-0.013		-0.017	
	(0.05)		(0.04)	
L.lnCaBal		-0.009		-0.016
		(0.05)		(0.04)
lnTrade	-0.472		-0.435	
	(0.53)		(0.35)	
L.lnTrade		-0.123		-0.315
		(0.42)		(0.31)
_cons	-5.906	-5.707	0.176	2.103
	(5.78)	(6.59)	(4.92)	(4.95)
R^2	0.312	0.284	0.366	0.246
Observations	251	235	362	326
Countries	29	29	43	42

* p<0.1, ** p<0.05, *** p<0.01

Table b.10: Gamma with lagged controls, FE

	(1)	(2)	(3)	(4)	(5)
	lnGamma	lnGamma	lnGamma	lnGamma	lnGamma
	b/se	b/se	b/se	b/se	b/se
lnA1	4.315***	0.538			1.351
	(1.05)	(0.96)			(1.08)
lnMacap	0.189		-0.129		-0.033
	(0.14)		(0.11)		(0.10)
lnAdr	-3.190***			-2.983*	-3.161**
	(1.08)			(1.52)	(1.37)
lnGdpPc	-2.194***				
	(0.71)				
lnGvtExp	-0.065				
	(0.59)				
lnInst	0.212				
	(0.52)				
lnDebt	-0.093				
	(0.19)				
lnGvtBal	-0.013				
	(0.06)				
lnTaxRev	0.704				
	(0.45)				
lnInfl	-0.047				
	(0.07)				
lnSavingR	0.057				
	(0.04)				
lnDepr	0.740				
	(1.09)				
lnCaBal	-0.013				
	(0.05)				
lnTrade	-0.472				
	(0.53)				
_cons	-5.906	-3.858	-0.681***	-6.105**	-14.673*
	(5.78)	(5.81)	(0.08)	(2.82)	(7.44)
R^2	0.312	0.004	0.022	0.101	0.122
Observations	251	251	251	251	251
Countries	29	29	29	29	29

* p<0.1, ** p<0.05, *** p<0.01

Table b.11: Gamma with sample from table 3.5 (column 5), FE

	(1) lnGamma b/se	(2) lnGamma b/se	(3) lnGamma b/se	(4) lnGamma b/se	(5) lnGamma b/se
lnCapprod_pub	-0.400**			-0.454**	-0.815***
	(0.19)			(0.21)	(0.18)
lnMacap		-0.057		0.109*	0.126
		(0.09)		(0.06)	(0.08)
lnAdr			-2.345*	-3.381**	-2.810**
			(1.35)	(1.55)	(1.09)
lnGdpPc					0.343
					(0.38)
lnGvtExp					-0.851
					(0.60)
lnInst					-0.473
					(0.32)
lnDebt					-0.429***
					(0.09)
lnGvtBal					0.014
					(0.06)
lnTaxRev					0.810***
					(0.20)
lnInfl					0.023
					(0.03)
lnSavingR					0.243***
					(0.06)
lnDepr					0.515
					(1.15)
lnCaBal					-0.017
					(0.04)
lnTrade					-0.435
					(0.35)
_cons	-0.189	-0.559***	-5.035*	-6.339**	0.176
	(0.13)	(0.11)	(2.67)	(2.82)	(4.92)
R^2	0.060	0.004	0.065	0.157	0.366
Observations	575	514	609	510	362
Countries	58	50	62	49	43

* p<0.1, ** p<0.05, *** p<0.01

Table b.12: Gamma and public capital productivity, FE

C Appendix: The commitment effect

C.1 Commitment effect and foreign debt

The derivative of $\tilde{D}^{F,c}$ with respect to the size of the older generation gives:

$$\frac{\partial \tilde{D}^{F,c}}{\partial \omega} = \frac{1}{2}\tilde{Y}^c \frac{\partial x}{\partial z}\frac{\partial z}{\partial \omega} + \frac{x}{2}\frac{\partial \tilde{Y}^c}{\partial \omega} \tag{C.1.1}$$

$$= \frac{1}{2}\alpha^{\frac{\alpha}{1-\alpha}} A^{\frac{1}{1-\alpha}} j^{\frac{-\alpha}{1-\alpha}} \frac{\partial z}{\partial \omega}\left[\frac{\partial x}{\partial z} - \frac{\alpha}{1-\alpha}\frac{x}{j}\frac{\partial j}{\partial z}\right],$$

where the first term in the first line as well as inside the bracket in the second line reflects the positive effect of the older generation's desire for consumption (*consumption effect*), and the second term in both lines captures the opposing *commitment effect*, respectively. The latter one leads to lower foreign debt in equilibrium.

Consequently, if the *consumption effect* dominates, the term in the bracket will be:

$$\frac{\partial x}{\partial z} - \frac{\alpha}{1-\alpha}\frac{x}{j}\frac{\partial j}{\partial z} > 0 \tag{C.1.2}$$

$$\epsilon_{x;j} := \frac{\frac{\partial x/\partial z}{x}}{\frac{\partial j/\partial z}{j}} > \frac{\alpha}{1-\alpha}$$

$\epsilon_{x;j}$ is not to be interpreted as an elasticity that has some economic meaning[1], but due to

[1] Just recall the expressions of x and j.

construction it is rather convenient to name it like this.

We will later use (C.1.2) to proof which of the effects is dominating the other one.

C.2 Commitment vs. consumption effect

In this section I will prove that the *consumption effect* always dominates the *commitment effect*.

From (4.19) we can build the derivative with respect to the political power of the old generation:

$$\frac{\partial \tilde{\gamma}^c}{\partial \omega} = 2\alpha(-1)(xj)^{-2}\Big[\frac{\partial x}{\partial z}\frac{\partial z}{\partial \omega}j + \frac{\partial j}{\partial z}\frac{\partial z}{\partial \omega}x\Big] \tag{C.2.1}$$

$$= -2\alpha\frac{\partial z}{\partial \omega}(xj)^{-2}\Big[\frac{\partial x}{\partial z}j + \frac{\partial j}{\partial z}x\Big] < 0$$

where we used the facts that $\frac{\partial x}{\partial z} = \frac{2}{z^3} > 0$ and $\frac{\partial j}{\partial z} = \frac{2+\frac{3}{z}-\frac{1}{z^3}}{(2.5+0.5z+\frac{1.5}{z}-\frac{0.5}{z^2})^2} > 0$.

If (C.2.1) holds, we know from the construction of $\tilde{\gamma}^c = \frac{\tilde{K}^{G,c}}{\tilde{D}^{F,c}}$, that also the following must hold:

$$\frac{\partial \tilde{\gamma}^c}{\partial \omega} = \frac{\frac{\partial \tilde{K}^{G,c}}{\partial \omega}\tilde{D}^{F,c} - \frac{\tilde{D}^{F,c}}{\partial \omega}\tilde{K}^{G,c}}{(\tilde{D}^{F,c})^2} < 0, \tag{C.2.2}$$

and from that:

$$\Big| \frac{\partial \tilde{K}^{G,c}}{\partial \omega} \tilde{D}^{F,c} \Big| < \Big| \frac{\partial \tilde{D}^{F,c}}{\partial \omega} \tilde{K}^{G,c} \Big| \tag{C.2.3}$$

$$\Big| -\tfrac{1}{1-\alpha} \alpha^{\frac{1}{1-\alpha}} A^{\frac{1}{1-\alpha}} j^{-\frac{2-\alpha}{1-\alpha}} \tfrac{\partial j}{\partial z} \tfrac{\partial z}{\partial \omega} \tfrac{x}{2} A^{\frac{1}{1-\alpha}} (\tfrac{\alpha}{j})^{\frac{\alpha}{1-\alpha}} \Big| < \Big| \tfrac{1}{2} \alpha^{\frac{\alpha}{1-\alpha}} A^{\frac{1}{1-\alpha}} j^{\frac{-\alpha}{1-\alpha}} \tfrac{\partial z}{\partial \omega} \Big[\tfrac{\partial x}{\partial z} - \tfrac{\alpha}{1-\alpha} \tfrac{x}{j} \tfrac{\partial j}{\partial z} \Big] (\tfrac{\alpha A}{j})^{\frac{1}{1-\alpha}} \Big|$$

$$\Big| -\frac{1}{1-\alpha} \frac{x}{j} \frac{\partial j}{\partial z} \Big| < \Big| \frac{\partial x}{\partial z} - \frac{\alpha}{1-\alpha} \frac{x}{j} \frac{\partial j}{\partial z} \Big|$$

$$\Big| \frac{1}{\alpha} \Big| < \Big| 1 - \tfrac{1-\alpha}{\alpha} \epsilon_{x;j} \Big|$$

In the latter expression the LHS will always be ≥ 1 as long as $0 \leq \alpha \leq 1$. Thus, for (C.2.3) to hold, the RHS has to be at least $\Big| \leq 1 \Big|$ as well. Having in mind from (C.1.2) that $\epsilon_{x;j} < \frac{\alpha}{1-\alpha}$ if the *commitment effect* dominates, one can easily infer, that this is not a valid solution for (C.2.3).[2]

Consequently, if (C.2.1) holds, the *consumption effect* must be larger (in absolute terms) than the *commitment effect*. As a result, the age structure of a society has a positive impact on the volume of foreign debt, i.e. $\frac{\partial \tilde{D}^{F,c}}{\partial \omega} > 0$ (cf. (C.1.1)).

C.3 Marginal effects of A and ω

This section derives the marginal effects of the two key country characteristics on the public investment quota $\tilde{q}^c_t$ and the foreign debt share $\tilde{s}^c_t$, respectively.

C.3.1 Effects of A and ω on $\tilde{q}^c$

I start with the effect of the TFP A on the share of public investment in total public expenditure $\tilde{q}^c_t$ for the case of default (cf. (4.17)):

[2] The RHS would take only values between 0 and 1.

$$\frac{\partial \tilde{q}_t^c(\varphi_t = 0)}{\partial A} = \frac{\frac{\partial \tilde{K}^{G,c}}{\partial A}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\zeta_t^c) - \tilde{K}^{G,c}(2\frac{\partial \tilde{Y}^c}{\partial A} + 2\frac{\partial \tilde{D}^{F,c}}{\partial A} - \frac{\partial \tilde{K}^{G,c}}{\partial A})}{(\Omega_t^c)^2(\varphi_t = 0)} \tag{C.3.1}$$

$$= \frac{-2\zeta_t^c \frac{\partial \tilde{K}^{G,c}}{\partial A}}{(\Omega_t^c)^2(\varphi_t = 0)} < 0$$

As $\frac{\partial \tilde{K}^{G,c}}{\partial A} > 0$ can easily be inferred from (4.5), the overall impact of TFP is negative in case of default.

If the government opts for repayment in t, the derivative looks the following:

$$\frac{\partial \tilde{q}_t^c(\varphi_t = 1)}{\partial A} = \frac{\frac{\partial \tilde{K}^{G,c}}{\partial A}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\hat{\zeta}^c - \tilde{R}^c D_t^{H,c}) - \tilde{K}^{G,c}(2\frac{\partial \tilde{Y}^c}{\partial A} + 2\frac{\partial \tilde{D}^{F,c}}{\partial A} - \frac{\partial \tilde{K}^{G,c}}{\partial A} - 2\frac{\partial \hat{\zeta}^c}{\partial A})}{(\Omega_t^c)^2(\varphi_t = 1)} \tag{C.3.2}$$

$$= \frac{-\tilde{R}^c D_t^{H,c} \frac{\partial \tilde{K}^{G,c}}{\partial A}}{(\Omega_t^c)^2(\varphi_t = 1)} < 0$$

Therewith, in both scenarios the government spends relatively less on public investment the more productive it is. This result is in contrast to what was derived in the basic model.

For the effect of ω on the investment quota we get in case of default:

$$\frac{\partial \tilde{q}_t^c(\varphi_t = 0)}{\partial \omega} = \frac{\frac{\partial \tilde{K}^{G,c}}{\partial \omega}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\zeta_t^c) - \tilde{K}^{G,c}(2\frac{\partial \tilde{Y}^c}{\partial \omega} + 2\frac{\partial \tilde{D}^{F,c}}{\partial \omega} - \frac{\partial \tilde{K}^{G,c}}{\partial \omega})}{(\Omega_t^c)^2(\varphi_t = 0)} \tag{C.3.3}$$

$$= \frac{(2\frac{\partial \tilde{K}^{G,c}}{\partial \omega}\tilde{Y}^c - 2\frac{\partial \tilde{Y}^c}{\partial \omega}\tilde{K}^{G,c}) - 2\frac{\partial \tilde{D}^{F,c}}{\partial \omega}\tilde{K}^{G,c} + \frac{\partial \tilde{K}^{G,c}}{\partial \omega}(2\tilde{D}^{F,c} - 2\zeta_t^c)}{(\Omega_t^c)^2(\varphi_t = 0)} < 0$$

Since each of the summands in the last line can be proved to be negative, the overall impact on q is also negative.

If the policymaker chooses repayment of debt, the derivative looks the following:

$$\frac{\partial \tilde{q}_t^c(\varphi_t = 1)}{\partial \omega} = \frac{\frac{\partial \tilde{K}^{G,c}}{\partial \omega}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\hat{\zeta}^c - \tilde{R}^c D_t^{H,c})}{(\Omega_t^c)^2(\varphi_t = 1)}$$
$$\frac{-\tilde{K}^{G,c}(2\frac{\partial \tilde{Y}^c}{\partial \omega} + 2\frac{\partial \tilde{D}^{F,c}}{\partial \omega} - \frac{\partial \tilde{K}^{G,c}}{\partial \omega} - 2\frac{\partial \hat{\zeta}^c}{\partial \omega} - \frac{\partial \tilde{R}}{\partial \omega} D_t^{H,c})}{(\Omega_t^c)^2(\varphi_t = 1)} \tag{C.3.4}$$

$$= \frac{(2\frac{\partial \tilde{K}^{G,c}}{\partial \omega}\tilde{Y}^c - 2\frac{\partial \tilde{Y}^c}{\partial \omega}\tilde{K}^{G,c}) - 2\frac{\partial \tilde{D}^{F,c}}{\partial \omega}\tilde{K}^{G,c} + \frac{\partial \tilde{K}^{G,c}}{\partial \omega}(2\tilde{D}^{F,c} - 2\hat{\zeta}_t^c - \frac{\partial \tilde{R}}{\partial \omega} D_t^{H,c})}{(\Omega_t^c)^2(\varphi_t = 1)}$$

A clear-cut statement is not possible in this case (remember the same outcome in equation B.1.6).

C.3.2 Effects of A and ω on $\tilde{s}^c$

Turning to the debt decision, the marginal impact of the TFP on the foreign debt quota is negative for the case of default

$$\frac{\partial \tilde{s}_t^c(\varphi_t = 0)}{\partial A} = \frac{\frac{\partial \tilde{D}^{F,c}}{\partial A}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\zeta_t^c) - \tilde{D}^{F,c}(2\frac{\partial \tilde{Y}^c}{\partial A} + 2\frac{\partial \tilde{D}^{F,c}}{\partial A} - \frac{\partial \tilde{K}^{G,c}}{\partial A})}{(\Omega_t^c)^2(\varphi_t = 0)}$$
$$= \frac{-2\zeta_t^c \frac{\partial \tilde{D}^{F,c}}{\partial A}}{(\Omega_t^c)^2(\varphi_t = 0)} < 0, \tag{C.3.5}$$

and if the government opts for repayment as well:

$$\frac{\partial \tilde{s}_t^c(\varphi_t = 1)}{\partial A} = \frac{\frac{\partial \tilde{D}^{F,c}}{\partial A}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\hat{\zeta}^c - \tilde{R}^c D_t^{H,c}) - \tilde{D}^{F,c}(2\frac{\partial \tilde{Y}^c}{\partial A} + 2\frac{\partial \tilde{D}^{F,c}}{\partial A} - \frac{\partial \tilde{K}^{G,c}}{\partial A} - 2\frac{\partial \hat{\zeta}^c}{\partial A})}{(\Omega_t^c)^2(\varphi_t = 1)}$$
$$= \frac{-\tilde{R}^c D_t^{H,c} \frac{\partial \tilde{D}^{F,c}}{\partial A}}{(\Omega_t^c)^2(\varphi_t = 1)} < 0 \tag{C.3.6}$$

Thus, in more productive countries the government tends to rely relatively more on domestic debt.

For the effect of ω we get in case of default:

$$\frac{\partial \tilde{s}_t^c(\varphi_t=0)}{\partial \omega} = \frac{\frac{\partial \tilde{D}^{F,c}}{\partial \omega}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\zeta_t^c) - \tilde{D}^{F,c}(2\frac{\partial \tilde{Y}^c}{\partial \omega} + 2\frac{\partial \tilde{D}^{F,c}}{\partial \omega} - \frac{\partial \tilde{K}^{G,c}}{\partial \omega})}{(\Omega_t^c)^2(\varphi_t=0)}$$

$$= \frac{\frac{\partial \tilde{D}^{F,c}}{\partial \omega}(2\tilde{Y}^c - \tilde{K}^{G,c} - 2\zeta_t^c) - \tilde{D}^{F,c}(2\frac{\partial \tilde{Y}^c}{\partial \omega} - \frac{\partial \tilde{K}^{G,c}}{\partial \omega})}{(\Omega_t^c)^2(\varphi_t=0)} > 0 \tag{C.3.7}$$

The expression in the first bracket is positive, because ($\tilde{Y}^c \geq \tilde{K}^{G,c}$) and at the same time ζ_t^c will never be larger than $\frac{1}{2}(1-\frac{1}{z})\tilde{Y}^c$ (see figure 4.2) - otherwise the default will not take place. In the second bracket it can be proven that $(2\frac{\partial \tilde{Y}^c}{\partial \omega} - \frac{\partial \tilde{K}^{G,c}}{\partial \omega})$ is negative as long as $j > 0.5$, which is always the case (cf. footnote 12). This makes the overall effect of ω on the foreign debt quota positive in case of default.
If the policymaker chooses repayment, the derivative looks the following:

$$\frac{\partial \tilde{s}_t^c(\varphi_t=1)}{\partial \omega} = \frac{\frac{\partial \tilde{D}^{F,c}}{\partial \omega}(2\tilde{Y}^c + 2\tilde{D}^{F,c} - \tilde{K}^{G,c} - 2\hat{\zeta}^c - \tilde{R}^c D_t^{H,c})}{(\Omega_t^c)^2(\varphi_t=1)}$$

$$\frac{-\tilde{D}^{F,c}(2\frac{\partial \tilde{Y}^c}{\partial \omega} + 2\frac{\partial \tilde{D}^{F,c}}{\partial \omega} - \frac{\partial \tilde{K}^{G,c}}{\partial \omega} - 2\frac{\partial \hat{\zeta}^c}{\partial \omega} - \frac{\partial \tilde{R}}{\partial \omega}D_t^{H,c})}{(\Omega_t^c)^2(\varphi_t=1)} > 0 \tag{C.3.8}$$

As again the first bracket's expression is positive and the second bracket's negative, the total impact of ω is positive also for the repayment case.

C.4 Additional regression tables

	(1) FD b/se	(2) FD b/se	(3) FD b/se	(4) FD b/se	(5) FD b/se	(6) FD b/se
L.lnA1	-1.307***	-1.257***	-2.272*			
	(0.40)	(0.38)	(1.15)			
L.lnCapprod_pub				-0.050	-0.054	0.049
				(0.05)	(0.05)	(0.09)
L.lnAdr			0.941			-0.301
			(0.96)			(0.74)
lnAdr		-0.351			0.216	
		(0.60)			(0.55)	
L.lnGdpPc			-0.689			-1.803***
			(0.68)			(0.32)
L.lnGvtExp			-0.130			0.227
			(0.24)			(0.18)
L.lnInst			-0.560**			-0.242
			(0.28)			(0.21)
L.lnDebt			0.031			0.480***
			(0.15)			(0.11)
L.lnGvtBal			0.008			0.009
			(0.05)			(0.04)
L.lnTaxRevGdp			-0.565*			-0.512***
			(0.32)			(0.19)
L.lnInfl			0.054			0.034
			(0.04)			(0.03)
L.lnSavingR			0.074***			0.072***
			(0.03)			(0.02)
L.lnDepr			-0.572			-0.271
			(0.80)			(0.82)
L.lnCaBal			-0.014			-0.021
			(0.03)			(0.03)
L.lnTrade			0.242			0.221
			(0.27)			(0.24)
_cons	6.056**	4.964*	15.593***	-1.395***	-0.900	7.662*
	(2.32)	(2.68)	(5.41)	(0.03)	(1.26)	(4.10)
R^2	0.050	0.052	0.186	0.002	0.004	0.235
Observations	1177	1177	421	1561	1561	563
Countries	74	74	50	115	115	70

* p<0.1, ** p<0.05, *** p<0.01

Table c.1: Foreign debt with lagged controls, FE

	(1)	(2)	(3)	(4)	(5)	(6)
	gFD	gFD	gFD	gFD	gFD	gFD
	b/se	b/se	b/se	b/se	b/se	b/se
lnA1	-0.115	-0.075	-0.036			
	(0.09)	(0.09)	(0.27)			
lnCapprod_pub				-0.035**	-0.032**	0.010
				(0.01)	(0.01)	(0.03)
lnAdr		-0.320*	-0.933***		-0.179**	-1.280***
		(0.19)	(0.18)		(0.09)	(0.34)
lnGdpPc			0.263			0.101
			(0.24)			(0.10)
lnGvtExp			-0.079			-0.033
			(0.14)			(0.13)
lnInst			-0.199			-0.144
			(0.13)			(0.10)
lnDebt			0.044			0.180*
			(0.07)			(0.09)
lnGvtBal			-0.043***			-0.005
			(0.02)			(0.03)
lnTaxRevGdp			-0.042			-0.117
			(0.10)			(0.14)
lnInfl			0.016			0.009
			(0.02)			(0.01)
lnSavingR			0.047***			0.033**
			(0.02)			(0.02)
lnDepr			0.316			0.379*
			(0.23)			(0.22)
lnCaBal			0.012			0.010
			(0.01)			(0.01)
lnTrade			-0.092			-0.046
			(0.08)			(0.09)
_cons	0.740	-0.229	-2.897**	0.095***	-0.313	-2.912*
	(0.54)	(0.74)	(1.29)	(0.01)	(0.20)	(1.47)
R^2	0.000	0.003	0.049	0.003	0.005	0.045
Observations	1095	1095	446	1481	1481	608
Countries	74	74	51	113	113	71

* p<0.1, ** p<0.05, *** p<0.01

Table c.2: Foreign debt growth rate, FE

	(1)	(2)	(3)	(4)	(5)	(6)
	gFD	gFD	gFD	gFD	gFD	gFD
	b/se	b/se	b/se	b/se	b/se	b/se
L.lnA1	-0.060	-0.020	-0.092			
	(0.10)	(0.09)	(0.23)			
L.lnCapprod_pub				-0.017	-0.014	-0.017
				(0.01)	(0.01)	(0.03)
L.lnAdr			-0.204			-0.773**
			(0.23)			(0.34)
lnAdr		-0.327*			-0.194**	
		(0.18)			(0.09)	
L.lnGdpPc			0.857***			0.663***
			(0.19)			(0.10)
L.lnGvtExp			-0.360*			-0.183
			(0.19)			(0.15)
L.lnInst			-0.097			-0.006
			(0.10)			(0.09)
L.lnDebt			-0.354***			-0.223**
			(0.08)			(0.09)
L.lnGvtBal			-0.066***			-0.034*
			(0.02)			(0.02)
L.lnTaxRevGdp			0.050			-0.081
			(0.13)			(0.09)
L.lnInfl			-0.010			0.003
			(0.02)			(0.01)
L.lnSavingR			0.030***			-0.001
			(0.01)			(0.02)
L.lnDepr			-0.231			-0.287
			(0.19)			(0.21)
L.lnCaBal			-0.011			-0.005
			(0.02)			(0.02)
L.lnTrade			-0.094			0.050
			(0.08)			(0.09)
_cons	0.423	-0.556	-5.168***	0.082***	-0.360*	-7.190***
	(0.56)	(0.69)	(1.74)	(0.01)	(0.20)	(1.70)
R^2	0.000	0.003	0.103	0.001	0.003	0.056
Observations	1106	1106	422	1471	1471	560
Countries	74	74	50	115	115	70

* p<0.1, ** p<0.05, *** p<0.01

Table c.3: Foreign debt growth rate with lagged controls, FE

	(1)	(2)	(3)	(4)
	lnGamma	lnGamma	lnGamma	lnGamma
	b/se	b/se	b/se	b/se
lnA1	-0.127		-1.349	6.638***
	(1.56)		(1.36)	(1.79)
lnAdr		-8.664***	-8.983***	-6.439**
		(2.74)	(2.83)	(2.30)
lnGdpPc				-5.998***
				(1.05)
lnGvtExp				1.039
				(1.19)
lnInst				-2.028***
				(0.64)
lnDebt				-0.311
				(0.22)
lnGvtBal				0.090*
				(0.05)
lnTaxRevGdp				-0.875
				(0.57)
lnInfl				-0.096
				(0.07)
lnSavingR				0.740
				(0.66)
lnDepr				-4.157**
				(1.79)
lnCaBal				-0.026
				(0.05)
lnTrade				0.402
				(0.57)
_cons	-0.130	-13.694***	-5.708	-11.623*
	(9.75)	(4.04)	(7.94)	(5.56)
R^2	0.000	0.401	0.417	0.695
Observations	168	168	168	168
Countries	18	18	18	18

* p<0.1, ** p<0.05, *** p<0.01

Table c.4: Gamma for rich countries, FE

	(1)	(2)	(3)	(4)
	lnGamma	lnGamma	lnGamma	lnGamma
	b/se	b/se	b/se	b/se
lnA1	1.513		1.621	4.084**
	(0.91)		(1.14)	(1.69)
lnAdr		0.757	-0.143	-2.681
		(0.87)	(1.00)	(1.67)
lnGdpPc				0.724
				(0.77)
lnGvtExp				0.267
				(0.34)
lnInst				0.689
				(0.46)
lnDebt				0.402***
				(0.12)
lnGvtBal				0.044
				(0.06)
lnTaxRevGdp				0.037
				(0.44)
lnInfl				-0.021
				(0.04)
lnSavingR				0.122**
				(0.04)
lnDepr				-0.003
				(0.74)
lnCaBal				-0.004
				(0.03)
lnTrade				-0.203
				(0.40)
_cons	-8.548	2.037	-9.535	-36.526**
	(5.16)	(2.28)	(8.29)	(12.40)
R^2	0.071	0.024	0.072	0.317
Observations	94	94	94	94
Countries	12	12	12	12

* p<0.1, ** p<0.05, *** p<0.01

Table c.5: Gamma for poorer countries, FE

CURRICULUM VITAE

Name	Joachim Lutz
Geburtstag	27. Juli 1983
Geburtsort	Wertheim am Main
Staatsangehörigkeit	Deutsch
Adresse	Hegelstraße 58
	55122 Mainz

AKADEMISCHE AUSBILDUNG

2010 - 2015	Promotionsstudium an der Johannes Gutenberg-Universität Mainz (Dr. rer. pol.)
2009 - 2010	Promotionsstudium an der Rheinisch-Westfälischen Technischen Hochschule Aachen
2003 - 2009	Studium der Volkswirtschaftslehre an der Bayerischen Julius-Maximilians-Universität Würzburg (Diplom-Volkswirt)
2006 - 2007	Studium der Volkswirtschaftslehre an der Univerza v Mariboru, Slowenien